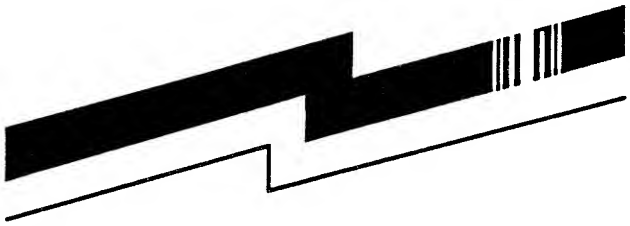

Wireless Service
Task Force

Emerging Wireless Services Report

September 1995

EXECUTIVE SUMMARY

This report presents the findings, conclusions, and recommendations of the Wireless Services Task Force (WSTF) of the President's National Security Telecommunications Advisory Committee (NSTAC) concerning emerging wireless services and their relationship with National Security and Emergency Preparedness (NS/EP) telecommunications. The primary areas addressed, at the direction of the NSTAC's Industry Executive Subcommittee (IES), include cellular wireless priority access, and a scoping effort covering land mobile radio/specialized mobile radio (LMR/SMR), mobile satellite service (MSS), personal communications service (PCS), and mobile wireless access to data networks.

This paper summarizes the results of the Task Force investigations, provides an overview of the variety of systems existing or being developed and implemented, discusses some of the current issues of concern, and recommends a number of follow-on actions.

The Federal Government is often called upon for support in NS/EP operations, such as responding to major disasters. Therefore, the Government is interested in the emerging mobile wireless communications technologies which could assist in meeting these emergency support requirements. The Government is particularly interested in mobile wireless communications services that appear to the user to be universally interoperable and available using common devices. Among the principal Government concerns with these emerging communications technologies are: (1) the absence of universally compatible interfaces and control standards for the various types of digital wireless services, and (2) many different wireless networks are evolving independently, creating potential interoperability problems.

The WSTF formed subgroups to conduct in-depth reviews. The subgroups were: the Cellular Priority Access Service (CPAS) Subgroup, to work with the Government to achieve call-by-call priority access service for cellular radio; and four scoping subgroups to address the four areas noted earlier: LMR/SMR, MSS, PCS, and mobile wireless access to data networks. This report includes a compilation of the subgroup reports, covering the five wireless subgroups: CPAS, LMR/SMR, MSS, PCS, and mobile wireless access to data networks. The Task Force reviewed the results presented by each of the subgroups and, where a consensus was reached, developed a comprehensive list of conclusions and recommendations.

The Task Force has completed its scoping task and has concluded that these emerging wireless technologies could provide significant capabilities to NS/EP communications support. It has identified a number of areas that need further work by both Government and industry entities and has provided recommendations for resolution by the Government. These recommended actions address areas where the NSTAC could assist the Government. However, in most of these cases, the Government priorities are not clear to the Task Force. When Government priorities have been established, the NSTAC should be called upon by the Government to assist in their resolution, as appropriate.

Finally, the Task Force concluded that:

- A uniform, nationwide, ubiquitous CPAS capability would benefit Federal, State, and local NS/EP users and appears feasible in the near future.
- Industry and Government have successfully addressed many issues that are necessary for CPAS implementation, although technical, administrative, and regulatory issues remain.
- Continued Government and NSTAC involvement in support of the CPAS implementation process is important, as is continued inclusion of a wide array of CPAS stakeholders in the implementation process.
- NS/EP telecommunications capabilities could benefit from a joint industry-Government investigation of the use of new wireless technologies in NS/EP operations.
- It would be beneficial for Federal, State, and local representatives to collaborate on NS/EP issues involved in new and evolving wireless technologies.
- The efforts of the Office of the Manager, National Communications System (OMNCS) to update Emergency Support Function (ESF#2) of the Federal Response Plan are commendable. It is important to continue to work with the Federal Emergency Management Agency (FEMA) to strengthen the partnership with other annexes having a natural co-dependence with ESF#2, and for representatives of those disciplines to participate in ESF#2 training currently being planned.

To exploit these emerging wireless technologies, the Task Force recommends that the Government:

- Define and establish unified policies and requirements for wireless services in support of NS/EP activities at Federal, State, and local levels
- Identify NS/EP issues inherent in emerging technologies to include providing NS/EP orientation to newly involved entities
- Identify interoperability and security constraints inherent in emerging wireless technologies and determine alternative solutions, e.g., internetworking
- Identify approaches to providing end-to-end network privileges for NS/EP users associated with these new technologies, e.g., priority access, Government Emergency Telecommunications Service (GETS), etc.
- Foster international agreements and licenses for wireless technologies to support global emergency response efforts
- Continue support to the joint planning processes, such as was undertaken within the CPAS Subgroup, Federal Law Enforcement Working Group, Federal Wireless Policy

Committee (FWPC), Federal Wireless Users Forum (FWUF), Government Wireless Focal Point, National Performance Review (NPR)-IT04, National Security Telecommunications Advisory Committee (NSTAC), and the Public Safety Wireless Advisory Committee (PSWAC)

- Establish an office that aggressively involves all NCS organizations, State and local Governments, and the telecommunications industry to test, evaluate, demonstrate, train, and exercise the application of wireless technology in support of NS/EP operations.

The Government should continue its CPAS implementation efforts, coordinating with Federal, State, and local Governments, industry groups, and emergency management associations to gain broad consensus on regulatory, administrative, and technical issues and finalize a comprehensive strategy for CPAS implementation.

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INTRODUCTION

1.1 PURPOSE

This report presents the findings, conclusions, and recommendations of the Wireless Services Task Force (WSTF) of the President's National Security Telecommunications Advisory Committee (NSTAC) concerning emerging wireless services and their relationship with National Security and Emergency Preparedness (NS/EP) telecommunications. The primary areas addressed, at the direction of the NSTAC's Industry Executive Subcommittee (IES), include cellular wireless priority access and a scoping effort covering land mobile radio/specialized mobile radio (LMR/SMR), mobile satellite service (MSS), personal communications service (PCS), and mobile wireless access to data networks.

This paper summarizes the results of the Task Force investigations, provides an overview of the variety of systems existing or being developed and implemented, discusses some of the current issues of concern, and recommends a number of follow-on activities.

1.2 BACKGROUND

The Federal Government is often called upon for support in NS/EP operations, such as responding to major disasters. Therefore, the Government is interested in the emerging mobile wireless communications technologies which could assist in meeting these emergency support requirements. The Government is particularly interested in mobile wireless communications services that appear to the user to be universally interoperable and available using common devices. Among the principal Government concerns with the emerging communications technologies are: (1) the absence of universally compatible interfaces and control standards for the various types of digital wireless services, and (2) many different wireless networks are evolving independently, creating potential interoperability problems.

In 1991, the Office of the Manager, National Communications System (OMNCS), noted that certain developments in the evolving wireless digital telecommunications industry might affect the ability of the national telecommunications infrastructure to provide required support to NS/EP users, particularly with regard to interconnection with the Public Switched Network (PSN). Among the principal near-term concerns were: (1) the ability of evolving wireless digital telecommunications to support data, facsimile, and secure-voice when low-bit rate voice compression is used, (2) the current absence of industry-wide acceptance of interface and control standards regarding wireless digital services, and (3) the fact that several different types of wireless services are evolving, largely independent of each other, creating potential interconnectivity problems.

Working in conjunction with NCS member organizations, the OMNCS presented the issue to the IES of the President's NSTAC. The IES accepted the Government's request to address the issue and in March 1991 established a Task Force with instructions to:

- Scope the issues regarding wireless services so that industry and Government can best ensure maximum uniformity, transparency, and interconnectivity of emerging digital mobile and PCS for NS/EP communications.

- Consider specific standards and technical issues relative to access points, interfaces, PSN-generated control signals, and digital network timing and synchronization.

In the course of its work, the WSTF reviewed the status of North American wireless systems, including cellular telephone systems, mobile satellite systems, air-to-ground telephone systems, and personal communications networks (PCNs). The Task Force found that (1) the emerging wireless technologies would not support, in a standardized manner, some of the critical Government NS/EP telecommunications security requirements, e.g., Secure Telephone Units (STU-IIIs), and (2) the NS/EP requirements had not been clearly communicated to the standards community and telecommunications industry. Upon receipt of the Task Force/IES recommendations, the NSTAC made the following recommendations to the President:

- The Government should establish a focal point, supported by the National Security Agency (NSA) and the National Institute of Standards and Technology (NIST), to address and monitor wireless digital interface issues.

- The Government should formulate policies at a high-level to ensure NS/EP needs are taken into account in all wireless digital service acquisition activities.

The NSTAC also directed its IES to deactivate the Wireless Services Task Force until the Government focal point is established. The Secretary of Defense, as Executive Agent for the NCS, directed that the NSTAC's recommendations be immediately implemented by the Manager of the NCS, including the establishment of a Government focal point to address digital wireless issues.

In 1992 and 1993, pursuant to direction of the IES, the NSTAC Plans Working Group instructed the reactivated Task Force to:

- Support, and provide industry perspective to, the Government wireless services focal point.

- Continue and extend the earlier NSTAC investigation into wireless services supporting NS/EP.

- Survey the evolving wireless services environment.

- Recommend actions to be taken by industry and Government to enhance wireless services to support NS/EP.

- Explore methods for incorporating priority access into wireless systems for NS/EP use.

- Determine the potential for emerging wireless technologies to complement existing communications support in the Federal Response Plan (FRP) ESF#2.

- Develop methods for resolving wireless standards issues.

In a report to the IES completed in January 1994, and subsequently approved by the IES and NSTAC, the Task Force made the following recommendations to the Government.

- Continue to pursue implementation of a single, nationwide priority access capability for NS/EP users which is:
  - Transparent to the NS/EP user for PSN access
  - Interoperable across service boundaries
  - Composed of multiple levels of priority, consistent with Telecommunications Service Priority (TSP) categories and criteria
  - Developed using the NSTAC Government-industry collaborative process
- Expand the FRP ESF#2 planning process to:
  - Include representatives of the U.S. telecommunications industry
  - Encompass an "all-hazards" approach making more effective use of wireless technologies and services
  - Include national disaster response programs (e.g., TSP, Telecommunications Electric Service Priority), jointly developed by industry and Government
  - Incorporate all agency-specific telecommunications response plans into a single plan (ESF#2) that will be utilized in emergency situations
  - Expand the NCC role to provide active support for the FECC in a multi-vendor, wide-spread geographic-area disaster response situation
  - Periodically update the FRP ESF#2
- Develop and implement, in coordination with the cellular telecommunications industry, a nationwide process to enable immediate activation of NS/EP users' cellular telephones prior to arrival at a disaster location

- Continue efforts to define, establish, and unify policy and requirements for wireless services.

On 2 March 1995, the IES instructed the reactivated Task Force to:

- Continue Wireless Services Task Force support to Federal Government efforts to implement Cellular Priority Access Service (CPAS). Provide advice, assist in dealing

with standards and other industry bodies, support CPAS implementation activities with users and service providers, and participate in joint meetings.

- Determine the NS/EP implications and scope the future Task Force involvement in the following emerging wireless systems and report to the IES

  - LMR/SMR

  - MSS

  - PCS

  - Mobile wireless access to data networks

1.3 GOVERNMENT ACTIVITIES

As a result of the recommendations of the original Task Force, in November 1991, the OMNCS was identified as the Federal Government's focal point for addressing and monitoring wireless digital interface issues. Further, the OMNCS, in conjunction with other Government agencies, e.g., the Department of Commerce's NIST, the Department of Defense, the NSA, the General Services Administration (GSA), and the Federal law enforcement community, established the Federal Wireless Users Forum (FWUF). The objectives of the FWUF are to: (1) educate Federal Government users about wireless telecommunications, (2) identify the wireless telecommunications needs of Federal Government users, (3) facilitate an information exchange between wireless user groups, standards organizations, manufacturers, and service providers to ensure that Government user needs are met, and (4) support the interoperability of emerging wireless services and equipment through increased participation in the formulation of Federal policy, support of standardization efforts, and other appropriate activities. Subsequently, the interagency Federal Wireless Policy Committee (FWPC) was established, chaired by a representative of the National Telecommunications and Information Administration (NTIA), with the NCS providing the FWPC vice-chair. The FWPC is a committee of high-level representatives of the major Federal agencies, the National Association of State Telecommunications Directors (NASTD), and the Association of Public-Safety Communications Officials (APCO). The objective of the FWPC is to provide high-level guidance and direction for the development and implementation of Federal Government wireless policy. The FWPC has four subcommittees with the following areas of responsibility: policy, standards and requirements, privacy and security, and acquisitions. The FWPC, in conjunction with the Defense Information Systems Agency and Defense Information Technology Contracting Office (DITCO), issued a Request for Information (RFI) with respect to the acquisition of wireless services, with the aim of achieving a common wireless services procurement contract which can be used by Federal, State, and local agencies.

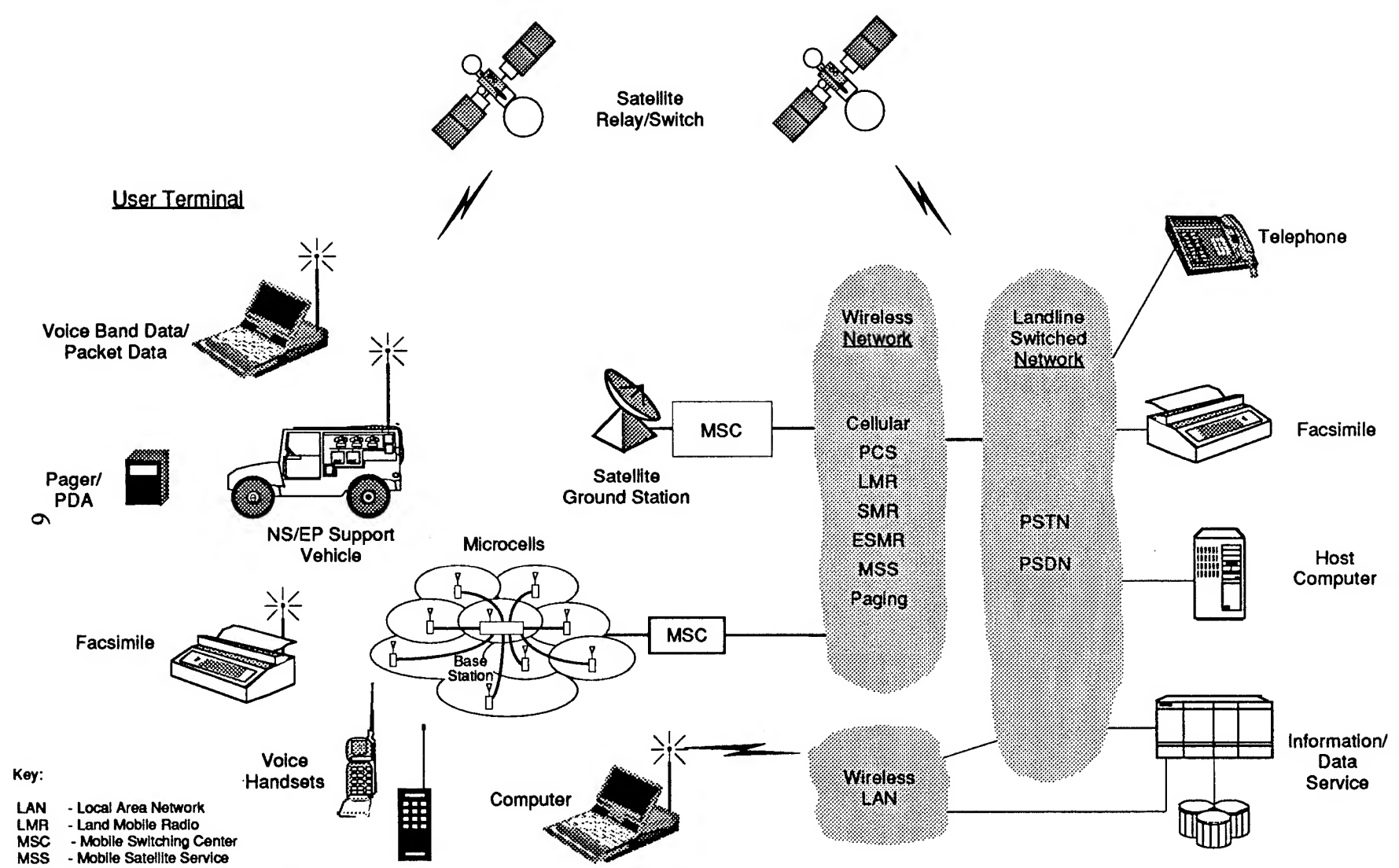
1.4 APPROACH

The WSTF formed subgroups to conduct in-depth reviews. The subgroups were: the CPAS Subgroup, continuing from the previous NSTAC cycle, to work with the Government to

achieve call-by-call priority access service for cellular radio; and four scoping subgroups to address the four areas noted earlier (LMR/SMR, MSS, PCS, and mobile wireless access to data networks). The results of the Task Force were based on briefings, research, the membership expertise, and meeting discussions. The Government provided the secretariat staff function through the OMNCS. The Appendix lists the Task Force members, subgroup chairpersons, key secretariat staff personnel, and other significant industry contributors to the effort.

This report includes a compilation of the Subgroup reports in Sections 2 through 6, covering the five wireless subgroups: CPAS, LMR/SMR, MSS, PCS, and mobile wireless access to data networks. The Task Force reviewed the results presented by each of the subgroups and, where a consensus was reached, developed a comprehensive list of conclusions and recommendations. The resulting Task Force conclusions and recommendations are listed in Sections 7 and 8.

The several emerging wireless services covered in this report are illustrated conceptually in Figure 1. They all share the common attribute of providing a communications capability to users through the use of mobile terminals which can be used to communicate with other mobile terminals directly or through a relay station/network, or provide a means of communicating with terminals connected through wireline facilities. From an NS/EP perspective, the emerging wireless services provide flexibility in movement, as well as access in remote areas, by removing the tether of a wireline connection.



Key:

LAN - Local Area Network
LMR - Land Mobile Radio
MSC - Mobile Switching Center
MSS - Mobile Satellite Service
PDA - Personal Digital Assistant
PCS - Personal Communications Service
PSDN - Public Switched Data Network (including the Internet)
PSTN - Public Switched Telephone Network
SMR - Specialized Mobile Radio
ESMR - Enhanced Specialized Mobile Radio

Figure 1. Emerging Wireless Service

SECTION 2

CELLULAR PRIORITY ACCESS SERVICE

2.1 OVERVIEW

The NSTAC WSTF established the CPAS Subgroup in July 1994 to investigate technical, administrative, and regulatory issues associated with the deployment of nationwide CPAS capability. The CPAS Subgroup's effort to define, standardize, and encourage CPAS deployment was prompted by recent emergency situations in which disaster response operations were hindered by cellular network congestion caused by extraordinary demand for mobile communication services. Recent significant events include the Oklahoma City bombing in April 1995, the Pittsburgh plane crash in September 1994, the Northridge earthquake in January 1994, and Hurricane Andrew in August 1992. Federal, State, and local officials responding to those disaster situations frequently encountered blocking of their cellular call attempts and were forced to redial repeatedly to gain access to the cellular system. This resulted in significant delays in critical communications affecting disaster response.

The WSTF CPAS Subgroup meetings provided a forum for government and industry organizations to define, scope, and address the many difficult issues related to this topic. It also provided a platform for developing a comprehensive CPAS implementation strategy. The subgroup participants are attempting to provide guidance and assistance to the OMNCS and other Federal Government organizations in their efforts to attain a nationwide cellular priority access capability in support of NS/EP telecommunications. The OMNCS, in a letter from the President in January 1995, was tasked to develop a capability to provide NS/EP users with priority access into wireless communications systems.

In addition to using cellular networks during regional and national disaster response activities, local emergency management teams also use cellular communications when responding to less drastic situations, such as auto collisions and forest fires. Each State and local jurisdiction, therefore, has a stake in the development of a CPAS capability. However, rather than having each jurisdiction require its cellular providers develop unique priority capabilities, as pending legislative and regulatory action in some States would do, the development of a nationwide approach was recommended. This approach would increase the likelihood that NS/EP users anywhere in the nation could gain access to cellular telephone networks during disaster situations, especially as disaster response teams moved from location to location.

The CPAS initiative has been supported by equipment manufacturers and cellular service providers, representatives from standards organizations and industry associations, Federal and State Government agencies, and emergency management associations. It will be essential for the Federal Government, in its role as Project Manager, to continue to interact with and seek input from those stakeholders to ensure a broad base of support for a nationwide, ubiquitous CPAS capability.

The CPAS Subgroup has written a report covering its findings, conclusions, and recommendations to date. The CPAS report is being issued as a separate document from this WSTF report. The CPAS report represents work in progress on administrative, technical,

regulatory, and implementation issues. Included in the document are suggestions to OMNCS in its role as Project Manager to increase the probability of a nationwide deployment.

2.2 SERVICE DESCRIPTION

CPAS is a call-by-call priority scheme for cellular communication systems providing priority handling of call attempts originating from qualified NS/EP cellular users. As planned, CPAS would mitigate the problem of blocked NS/EP cellular calls with minimal incremental effect on nonpriority calls. The CPAS capability has the following characteristics, based on requirements outlined by the Federal Government:

- Uniform implementation nationwide
- Priority access from the mobile station to cell sites
- Employment of a nonpreemptive, priority queuing-based technique
- Multiple priority levels
- Access via standard, commercially available handsets
- User identification based on mobile identification number/electronic serial number
- Invocation via a two-digit feature code
- Support for both voice- and circuit-switched data applications

In addition, CPAS is expected to evolve and include the following additional feature characteristics in the future:

- Automatic roaming support
- One-time user registration
- Priority egress from the mobile switching center
- Compatibility with the Government Emergency Telecommunications System (GETS)

The CPAS Subgroup suggested that CPAS be phased in across the nation, with priority deployment in high-risk areas. The OMNCS has identified these areas, and included them in a list of metropolitan statistical areas requiring CPAS within 1 year of the award of the Federal wireless services procurement contract. In addition, priorities could be provided to commercial customers at carriers' discretions, as long as priority levels assigned to such subscribers were below authorized NS/EP user priorities.

2.3 SERVICE ADMINISTRATION

The CPAS Subgroup determined that CPAS would require a structured management and administration system to ensure that priority assignments are issued only to authorized users. The subgroup addressed a number of key administrative issues, such as: whether to implement a centralized or decentralized management structure, what entity to assign the administration of a cellular priority access system, what authority would provide oversight, what criteria should be used to assign priority access, what specific operational procedures would be required to ensure the continued viability of the system, and what legal and regulatory framework would be the best service enabler.

The CPAS Subgroup concluded that it would be desirable to centralize priority access administration within one Federal Government office. Centralized administration would ensure uniform and consistent application of rules, procedures, and qualifications, and would provide a single point of contact for information and problem resolution. Centralized administration would also simplify priority access procedures for cellular service providers.

The subgroup also concluded that the OMNCS would be a logical choice to administer CPAS because it already supported the NS/EP telecommunications requirements of the 23 Federal agencies and has experience in administering telecommunications priorities through the TSP System.

The TSP System construct has a number of attributes that could apply, with minor modification, to CPAS and eliminate the need to establish nearly duplicate support capabilities, including the regulatory and oversight structures and a management information system. In addition, it would leverage administrative duties and staffing to cut administrative costs.

CPAS authorization criteria will have five priority levels assigned according to the user's function, mission, and needs. The criteria should favor State and local first-responder leadership by qualifying them for one of the highest priority levels. Development of a draft of those criteria has taken considerable effort, involving a range of stakeholders. It is planned that approval of those criteria and other significant issues will be obtained through the Federal Communications Commission (FCC) rule making.

The OMNCS plans to circulate draft CPAS rules before officially filing the petition with the FCC in December 1995. Because of the extensive outreach program the OMNCS plans to conduct, comments on the petition should be supportive, and an FCC ruling is expected within 12 months of filing. Though the FCC would need to rule that CPAS does not violate the Communications Act of 1934, the TSP System sets a precedent for priority treatment in the PSN and for FCC oversight of CPAS. The subgroup, however, noted the possible impact of the FCC s wireless 9-1-1 docket on CPAS implementation, and recommends that the OMNCS continue to monitor this proceeding. Present CPAS technical plans do not include an automatic priority for all 9-1-1 calls.

The CPAS administrative office would determine users' priority levels. The specifics of how the request and response would be structured and transmitted to the various parties involved are now in progress. The use of an authorizing agent who would be appointed by the states and who would serve as a regional or vocational intermediary between the user and the CPAS administrative office appears to have real merit.

Successful CPAS implementation will require users and service providers to agree on capabilities, administration, authorization, and use. The OMNCS is developing an outreach program to open a national discourse on CPAS and includes a needs analysis, a service definition, an administrative and regulatory plan, and an implementation road map. The intention of this effort is to ensure that the CPAS capability will truly meet the needs of the nation and it is supported at the grassroots level.

2.4 CONCLUSIONS

The WSTF CPAS Subgroup has come to the following conclusions:

- A uniform, nationwide, ubiquitous CPAS capability would benefit Federal, State, and local NS/EP users and appears feasible in the near future.
- Industry and Government have successfully addressed many issues that are necessary for CPAS implementation, although technical, administrative, and regulatory issues remain.
- Continued Government and NSTAC involvement in support of the CPAS implementation process is important, as is continued inclusion of a wide array of CPAS stakeholders in the implementation process.

2.5 RECOMMENDATION

The Government should continue its CPAS implementation efforts, coordinating with Federal, State, and local Governments, industry groups, and emergency management associations to gain broad consensus on regulatory, administrative, and technical issues and finalize a comprehensive strategy for CPAS implementation.

SECTION 3

LAND MOBILE RADIO/SPECIALIZED MOBILE RADIO

3.1 LMR/SMR OVERVIEW

LMR is a generic term used to describe a variety of radio communications services, which provide radio communications between a land mobile terminal and a base station, or between mobile terminals, including one-to-many or one-to-one communications. The base stations usually act as a relay between mobile terminals, but provisions exist to permit direct mobile-to-mobile communications in some instances. The LMR concept of operation was illustrated generically in Figure 1. In the case of LMR, mobile terminals are served by a base station and multiple relays to extend the coverage area, and provide a mechanism to make connections to the public switched telephone network (PSTN) or public switched data network (PSDN). Principal users of LMR systems include the military services, Federal law enforcement agencies and other Federal departments and agencies, State and local public safety and other service agencies, business organizations, and utilities. Typically, the FCC issues licenses to individuals or organizations to operate an LMR system on specific radio frequencies. The Federal Government is currently the largest user of LMR systems.

LMR services are attractive for communications supporting disaster situations, because they are generally not dependent on the PSTN, which may be damaged, or congested with commercial traffic. The LMR systems may also be damaged in a disaster, but when operational, they can normally provide a connection to the PSTN when necessary.

There are two types of LMR systems, conventional and trunked. The difference between conventional LMR systems and trunked radio systems is that users of conventional LMR systems operate on an assigned frequency in their designated geographic area, whereas with trunked systems the channels are pooled for automatic channel-sharing by numerous users on a demand-assignment basis, thus making more efficient use of the radio spectrum. A major difference between trunked radio and cellular radio operation is that trunked radio users can be grouped together into "talk groups." A user can address a talk group by selecting the designated group and pushing a talk button on the terminal to address the entire talk group, versus cellular radio operation where a user enters the telephone number of the called party and the cellular system sets up an end-to-end connection between the two users.

SMR was created by the FCC as a special LMR service to provide land mobile radio communications on a commercial basis to users who could themselves have been licensed to have their own private LMR service. Two distinct sets of frequencies have been set aside in the 800 MHz and 900 MHz frequency bands by the FCC for commercial SMR operations. These SMR systems are operated by private dispatch carriers to provide land mobile communications services on a commercial basis. The SMR licensee may permit automatic interconnection of mobile users to the PSTN and local telephone companies are required to offer interconnection arrangements to SMR operators.

Enhanced SMR (ESMR) systems are improved versions of SMR using digital technology. When deployed, they will (1) provide higher quality voice service, (2) facilitate hand-off

between stations, and (3) provide additional capabilities such as data services, closed user groups, and privacy. At least two companies are in the process of implementing commercial ESMR systems. One company has ESMR systems operational in a few areas, such as California, using Time Division Multiple Access (TDMA)-based equipment developed by Motorola, called the Motorola Integrated Radio System (MIRS). Another company is implementing ESMR systems based on the frequency-hopping multiple access technology, with the first operational system in Philadelphia, Pennsylvania.

Extensive efforts have been expended by user groups, standards bodies, and LMR suppliers to arrive at a single-point, standardized solution for the new generation of LMR systems. The focal point for this effort is a standardization program, called APCO Project 25, conducted by the APCO, the NASTD, and the Federal Government. The effort has resulted in the specification of a conventional air interface for non-trunked LMR systems to provide radio compatibility between next-generation conventional, digital, LMR radios. These efforts do not, however, address the interoperability needs of the SMR(ESMR) systems that are being developed for commercial applications.

An important initiative of the National Performance Review (NPR) is attempting to make Public Safety LMR a viable NS/EP telecommunications solution. This initiative, called NPR-Information Technology 04 (NPR-IT04) calls for establishing a National Law Enforcement/Public Safety Wireless Network for use by Federal, State, and local Government entities. As envisioned, this network should meet the digital, ubiquitous, interoperable, transparent, and secure (DUITS) requirements for NS/EP telecommunications.

3.2 LMR/SMR REGULATORY FACTORS

The FCC has published its intent to "re-farm" much of the VHF/UHF spectrum (i.e., to reassign frequencies among users throughout the spectrum), in order to make better use of all frequencies. At the present time, individual communications channels, assigned to Federal and public safety LMR users, occupy 25 kilohertz (kHz) of bandwidth per channel. In order to increase the number of available channels, it is desired to reduce this bandwidth by a factor of two in the late 1990s (to 12.5 kHz), with a goal of achieving a further reduction to 6.25 kHz in the future. The migration cost-effectiveness issue is closely related to bandwidth, since many of the several million users of LMR systems may find it necessary to replace or modify their existing 25 kHz systems at least once during the next 10-15 year period, and possibly twice.

The FCC, in a notice of proposed rulemaking last fall, docket 93-144, indicated the possibility of designating a contiguous 10 MHz segment with the 800 MHz band (currently divided into 200 channels) for licensed SMR use. An additional 4 MHz of non contiguous spectrum (80 channels) would also be provided to accommodate traditional SMR systems, such as those used by radio dispatch operators. If the FCC implements its wide-area SMR licensing program, existing SMR systems currently operating in those frequency bands would face relocation. The FCC is addressing what type of relocation programs to implement, and whether it should be mandatory, voluntary, or compensatory. It is also identifying spectra to satisfy the systems supplanted by the wide-area licenses.

The FCC and NTIA have created a Public Safety Wireless Advisory Committee (PSWAC) to prepare a final report to advise the NTIA and the FCC on operational, technical, and spectrum requirements of Federal, State, and local public safety entities through the year 2010. This committee is charged to resolve the issue of sufficient, contiguous spectrum in an optimum band for the implementation of the NPR-IT04 initiative to meet the needs of public safety entities. The proper allocation of radio spectrum for a nationwide wireless network will be a major factor in meeting the NS/EP telecommunications requirements.

3.3 LMR/SMR ISSUES

A number of potential issues concerning the NS/EP use of LMR/SMR are summarized below. The Federal telecommunications procurement initiatives and the Government's functional requirements for DUITS wireless services are important factors for consideration, although they are initially being applied to cellular radio-type services. The Government requirements for wireless services include voice, data, facsimile, paging, and imagery. The Government is exploring alternatives to purchasing and owning wireless communications equipment, as demonstrated by the FWPC effort to establish a leasing strategy for future wireless procurements. The potential NS/EP features are discussed, beginning with the features identified in the FWPC DUITS requirements statement, and the capability of each system type, LMR and SMR(ESMR), to provide those features is summarized in Table 1.

Table 1. LMR and SMR(ESMR) Features for NS/EP

System Type/ Feature	LMR	SMR(ESMR)
Digital	Future capability	ESMR capability
Ubiquitous	National Federal systems exist	No (national systems planned)
Interoperable	No	No
Transparent	No	Yes
Secure	Yes	Yes

3.3.1 Digital

In order to be able to take advantage of the many features of the emerging wireless technologies, such as the capability to easily encrypt the communications, the Government objective is to obtain systems which are based on the most modern digital technology. Currently, both existing LMR and SMR systems are primarily analog-based systems, but digital-based systems are beginning to emerge. Therefore, the availability of digitally-based LMR/SMR(ESMR) systems for future Government use is not expected to be a major issue or concern.

3.3.2 Ubiquitous

In support of NS/EP communications, the Government objective is to be able to use their wireless terminals anywhere in the U.S., and not be limited to specific geographic areas. Currently, there are a few Federal LMR systems which have frequency allocations across the entire nation. These frequency allocations are generally assigned to designated groups on a regional basis and controlled locally, so there is limited capability for users in one area to travel to another area and still be able to use their terminal equipment. These systems are generally not available for NS/EP users involved in emergency support roles. There appear to be limited opportunities to take advantage of the Federally allocated LMR frequencies in support of emergency preparedness situations. However, the NPR-IT04 initiative provides an opportunity to bring the Federal LMR systems together with the State and local Governments to support NS/EP telecommunications. In the case of SMR(ESMR), a few providers have plans to expand their new digital systems nationwide, but they are currently only available in a few isolated areas. Closely related to ubiquity is the issue of interoperability which is discussed below.

3.3.3 Interoperability

There is currently a very large Government inventory of LMR equipment. There is significant evidence that it is not well organized to support emergency response activities, although it has been used in such cases. For example, the Department of Defense and the U.S. Forest Service both have some LMR equipment set aside for use in emergencies. Of particular concern is the lack of interoperability between LMR systems from different manufacturers, as well as the apparent lack of guidance and procedures for utilizing LMR systems for communications support in emergency response activities. With the completion of the APCO Project 25 Common System Standard for Digital Public Safety Communications and its adoption by the Federal Government as an interim Federal Standard, interoperability between LMR systems and equipment from various manufacturers, used for NS/EP support, will be more likely. There is also concern about the emerging wireless systems, since the various SMR(ESMR) systems are being developed independently of each other, without the benefit of formal standards efforts.

There are a number of factors related to interoperability which could be considered to assist NS/EP communications support development. For example, even if terminal and air-interface standards are adopted, if the systems operate on different frequencies, there will still be a lack of interoperability between systems. Terminals with frequency selection capabilities might reduce this lack of interoperability in LMR systems. Another possibility is the Government acquisition of base station equipment that can be transported to disaster recovery locations as part of the emergency communications suite, to provide the necessary interconnectivity between systems.

Reasons cited for lack of interoperability for LMR/SMR(ESMR) systems include the disparate radio frequency allocations by the FCC and NTIA/Interdepartment Radio Advisory Committee (IRAC), and the limited frequency agility capability of existing equipment, due to both regulations and hardware/software limitations of the past. With respect to Government agencies, for example, the IRAC generally allocates frequencies to a particular Government agency, and then that agency parcels out those frequencies to individual groups within that

organization. Further, the frequency bands available to Federal agencies do not necessarily have any relation to the frequency bands assigned for local and State public safety, emergency, and law enforcement entities, and in many cases are specifically assigned to different frequency bands. The WSTF could, in support of the NPR-IT04 initiative, undertake an investigation of the spectrum utilization and its impact on future communications support for emergency response efforts. There are a number of related factors, such as determining the potential for using the same frequencies for military tactical entities outside the continental U.S., adoption of a frequency band that is internationally agreed for emergency support functions, or allocation of a frequency band for use by all emergency response entities only within the U.S. This endeavor could be coupled into the future efforts of the FCC/NTIA advisory committee being set up to address frequency spectrum for public safety and law enforcement.

A number of Government users are moving to implement wireless data systems which are separate from the LMR systems that handle their voice traffic. One of the reasons for this divergence is that the requirements for data transfer tend to be less stringent than for voice, particularly regarding response time requirements. A common system for voice and data raises the need for full-duplex operation and a means to establish priority for use of the channels. An issue of potential concern to the WSTF, concerning the implementation of wireless data networks for LMR, is the lack of standards for such systems, and the consequent lack of interoperability which may result from these uncoordinated activities. The NPR-IT04 initiative could also be a solution for LMR data systems.

3.3.4 Transparency

Transparent network interworking is one of the Government objectives specifically identified as one of the DUITS requirements. It is expected that emerging wireless services will support applications that rely on existing wireline networks, such as the PSTN, the Integrated Services Digital Network (ISDN), or packet-switched networks. These applications include G3 facsimile, STU-III, and point-of-sale transactions which are currently supported by V-series modems over the existing wireline networks. The Government requirement is for these services to be transparent to the user across the wireless access services and the intervening wireline networks. Network interworking may be necessary to support transparent operation of these applications through the emerging wireless access services, including LMR/SMR(ESMR).

3.3.5 Security

Security is another one of the Government objectives specifically identified as one of the DUITS requirements. Government security requirements for LMR systems are currently being addressed by Federal participation in the APCO Project 25 standards process. Government and industry should work together to address security requirements for SMR(ESMR) systems. There are several aspects to the Federal security interests, including: confidentiality, integrity, authentication, availability, and accountability. Most of the Federal security requirements are the same as those which are important to the normal business user, although additional security requirements for Federal users have also been identified, such as maintaining confidentiality of the addressees. The Government objective is for wireless networks to support any user-provided security function (application-specific) transparently through the network. As noted above, there is a requirement for using existing, analog-based, STU-IIIs over the emerging

digital wireless communications systems, to preserve the confidentiality of end-to-end communications. Further, there may be a need to ensure that the next generation of STUs are compatible with the emerging LMR/SMR(ESMR) networks.

Government use of the new commercial SMR(ESMR) systems could be affected by the security capabilities of such systems, as well as their capability to support the use of Government-furnished security devices.

3.3.6 Priority Access

Gaining access to a cellular radio channel during disaster situations has been shown to be a significant problem, therefore, industry and Government are working together to develop a cellular priority access service for NS/EP users. The Government, as previously recommended by the WSTF, should have a uniform, nationwide priority access for local, State, and Federal agencies during emergencies, when local wireless networks become congested. A nationwide approach was recommended to ensure effective implementation of the wireless priority treatment. Priority access for LMR systems is not an issue, because the LMR systems are owned and operated by individual entities and priority access is a mandatory requirement for APCO Project 25 systems. However, SMR(ESMR) service would be provided by commercial providers, and access could be a problem for NS/EP users in disaster recovery operations. Something similar to the Priority Access and Channel Assignment (PACA) standard should be evaluated for SMR(ESMR) networks. This is a particular concern because currently there are no standards groups addressing SMR(ESMR) priority issues.

3.3.7 Government Emergency Telecommunications Service Compatibility

There are a number of issues associated with LMR/SMR(ESMR) compatibility with the GETS which might be addressed by a NSTAC entity, such as the relationship between GETS and priority access to radio channels. However, the Government should first clarify its requirements for GETS interactions with LMR/SMR(ESMR) systems.

3.4 LMR/SMR CONCLUSIONS AND RECOMMENDATIONS

This initial scoping effort determined that the Government is a heavy user of LMR systems, and that there are emerging potential service providers of SMR(ESMR) services, which might be used for NS/EP communications. These LMR and SMR(ESMR) systems are primarily proprietary systems that allow communications between groups of users, as well as connection to the PSTN, and serve as an alternative to cellular radio systems. However, the APCO Project 25 standards program and the planned NPR-IT04 National Law Enforcement/Public Safety Wireless Network for use by both Federal, State, and local Government entities will make LMR a viable NS/EP telecommunications alternative. APCO Project 25 addresses LMR user needs for data, security for voice and data applications, as well as priority access. The subgroup recommendations and issues for consideration are:

1. Continue the planned NPR-IT04 National Law Enforcement/Public Safety Wireless Network for use by Federal, State, and local Government entities.

2. Support the PSWAC, which is to advise the NTIA and the FCC on operational, technical, and spectrum requirements of Federal, State, and local public safety entities through the year 2010.

3. Complete the APCO Project 25 standards program and support adoption of Federal LMR standards.

4. Determine the functional requirements for a gateway to provide interoperability between commercial SMR(ESMR) systems using different access schemes.

5. Investigate spectrum utilization for LMR/SMR(ESMR) and its impact on future communications support for emergency response efforts.

6. Determine the potential interactions of GETS and the use of LMR/SMR(ESMR) for NS/EP communications support.

7. Determine the need for standards for data over SMR(ESMR) systems, and the mechanisms to achieve industry consensus.

8. Identify requirements for including security interfaces in SMR(ESMR) equipment.

9. Determine a priority access methodology for SMR(ESMR) use which is in concert with the cellular priority access service currently being addressed.

SECTION 4

MOBILE SATELLITE SERVICE

4.1 MOBILE SATELLITE SERVICE OVERVIEW

MSS is attractive for communications supporting disaster situations, because it extends mobile communications out of the local area. MSS is used in the wireless communications context as a generic term for telecommunications capabilities enabling a user equipped with a mobile terminal to communicate with others (another mobile, portable, or stationary terminal, or a PSTN subscriber) via one or more satellite relays and their associated up-links, cross-links, and down-links. This capability is based on advanced technology that permits single channel communication links via satellites in low earth orbit (LEO), medium earth orbit (MEO), highly (inclined) elliptical orbit (HEO), or geosynchronous earth orbit (GEO), using low-powered terminals that may be handheld, vehicle-mounted, or stationary. Current systems providing MSS use geostationary satellites suitcase- and briefcase-size terminal equipment. Technological advances, primarily on the spacecraft, have led to plans for a variety of LEO, MEO, and HEO satellite-based systems that will allow for the use of smaller and even handheld terminals. Figure 1 includes the MSS concept of mobile subscribers being served by satellite to communicate with others through a ground station connected to the PSTN or PSDN.

Existing GEO satellite system terminals are used for voice and data involving land and sea vehicles, aircraft, marine-based platforms, and remote data collection sites. Future systems for MSS will support low-powered, handheld devices for a variety of services including both voice and data transmission. These systems are being developed to support real-time voice and data. Systems providing MSS will include several different types of communications channels, including circuit-switched channels for full period voice and data users; store-and-forward packet channels for transmission of small quantities of data with limited delivery time constraints; and interactive packet data channels for time-critical applications. These communications channels can be used in a number of different ways, including: voice services with a mobile telephone capability similar to cellular telephone, but with a much wider coverage area (in this case a gateway station is interconnected with the PSTN and communicates with the mobile terminal(s) through the satellite); position reporting/tracking; vehicle routing control; paging, message, or facsimile delivery; and emergency message applications. Future systems providing MSS are expected to have an inherent position-locating capability to satisfy national regulatory requirements.

Systems providing MSS are separated into three categories for discussion purposes: GEO satellite systems, "big" LEO systems, and "little" LEO satellite systems. The big LEO category includes both MEO and HEO satellite systems. With respect to the proposed LEO satellite systems, little or small LEO satellite systems have been defined as those systems operating in the radio frequency band below 1 GHz, and are limited to two-way data transfer and location-determination services. Big or large LEO satellite systems cover all types of services and operate in the frequency band between 1 and 3 GHz. GEO and big LEO systems will offer data services, as well as two-way circuit-switched digital voice between a mobile user and the PSTN/PSDN, a private network, or another mobile user.

Several of the significant systems providing MSS, existing and planned, which will be available in the near term, are listed below in Table 2. A subset of these systems was selected for more detailed investigation as they have received FCC licenses and are in operation, or close to operation. The selected systems are listed in Table 3, along with the services they will provide, terminal types, and the estimated initial operating capability time frame. The INMARSAT GEO system has been operational for several years. It was originally intended for maritime coverage, but now also provides land mobile and aeronautical services. Mobile Satellite (MSAT) will provide MSS for North America, including maritime service in coastal waters. American Mobile Satellite Corporation (AMSC) recently launched the first MSAT satellite into orbit and will initiate service in the Fall of 1995. The big LEO systems are planning to provide global coverage, subject to agreements with numerous foreign governments and their telecommunications entities. The little LEO ORBCOMM system has also launched its first two satellites and is planning to begin limited service capabilities this year as well.

4.2 MSS DISCUSSION

A major advantage of systems providing MSS, over purely terrestrial telecommunications systems, is the ability to deliver a range of services in regions lacking adequate terrestrial telecommunications. The terrestrial telecommunications in a region may be limited due to the geographic location, the consequence of a disaster situation, or the lack of a reliable terrestrial infrastructure. For example, AMSC, INMARSAT and Qualcomm currently provide MSS from GEO satellites to mobile users with transportable ship, air, or land-based terminals. INMARSAT services include circuit-switched telephone, telex, and facsimile; data connections for maritime and land applications; voice, data, automatic position, and status reporting for aircraft; and two-way communications, position reporting, and fleet management for land transport. Both AMSC and Qualcomm provide two-way, real-time messaging and positioning data between trucking and maritime fleets and their operation centers.

MSS is desirable for NS/EP communications support in a variety of different scenarios. A number of systems will provide MSS-enhanced communications mobility through the use of vehicular, transportable, and handheld terminals. A major advantage of MSS is that it provides "out-of-the-area" communications over long distances and on a global basis. MSS also can provide an alternative to the local telecommunications infrastructure, while allowing operation with the local facilities when they are available by connections made through a satellite ground station and the PSTN/PSDN. MSS provides enhanced flexibility to the NS/EP support elements, by not requiring installation of ground assets in the disaster area being served. MSS could be used in several different types of disaster situations, such as: in a metropolitan area where there has been significant damage to the infrastructure; cases where communications are needed in a remote area where there is no telecommunications infrastructure (e.g., forest fire); or in an international situation where no telecommunications infrastructure exists or where the local infrastructure is incompatible with U.S. equipment. For example; the National Disaster Medical System has six INMARSAT terminals which have been used in disasters, such as Hurricane Andrew, to provide out-of-the-area communications. Further discussion of these scenarios and potential for NS/EP use of MSS is described in reference 1.

Table 2. Systems Providing MSS

Category	System	Satellites	Major Organization
GEO	INMARSAT	4	COMSAT Mobile Communications (U.S. signatory to INMARSAT , an international consortium)
	MSAT	3	AMSC
	OmniTRACS		Qualcomm
Big LEO	Aries (LEO)	48	Constellation Communications
	Ellipso (HEO)	24	Ellipsat Corporation
	Globalstar (LEO)	48	Loral Qualcomm Satellite Services
	I-CO	10	COMSAT Mobile Comm. (Investor in I-CO Global Comm. Ltd.)
	Iridium (LEO)	66	Motorola Iridium
	Odyssey (MEO)	12	TRW
Little LEO	ORBCOMM	36	Orbital Sciences Corporation
	Starnet	24	Starsys Global Positioning
	Vitasat	2	Volunteers in Technical Assistance

4.3 MSS ISSUES AND CONCERNS

A number of issues and concerns with the NS/EP use of an MSS are summarized below. The Government's functional requirements for DUITS wireless services are important factors and are also addressed. The Government service requirements include voice, data, facsimile, paging, and imagery. The Government is exploring alternatives to purchasing and owning wireless communications equipment, through the FWPC effort to establish a leasing strategy for future wireless procurements. The potential NS/EP features are discussed in relation to each of the systems providing MSS, beginning with the features identified in the FWPC DUITS requirements statement.

4.3.1 Digital

To take advantage of the many features of emerging wireless technologies, such as the capability to easily encrypt communications, the Government objective is to obtain systems which are based on the most modern digital technology. All the existing or planned systems providing MSS are based on digital technology so there is no issue concerning this Government requirement.

4.3.2 Ubiquitous

To support NS/EP communications, the Government objective is to be able to use their wireless terminals anywhere in the U.S., and not be limited to specific geographic areas. The major advantage of utilizing MSS is the wide geographic coverage provided through satellite coverage, versus the limited geographic areas that are served by terrestrial wireless systems.

Table 3. Characteristics of Systems Providing MSS

System	Services	Terminals	IOC
INMARSAT(GEO)	Voice, HS/LS data, pos	Transportable, vehicular, maritime, aeronautical	Operational
MSAT(GEO)	Voice, LS data, pos	Transportable, vehicular, maritime < 200 miles from coast, aeronautical	1995
OmniTRACS(GEO)	LS data, pos	Transportable, vehicular	Operational
Globalstar (LEO)	Voice, LS data, pos	Handheld, transportable, vehicular	1998
Iridium (LEO)	Voice, LS data, pos	Handheld, transportable, vehicular	1998
Odyssey (MEO)	Voice, LS data, pos	Handheld, transportable, vehicular	1999
I-CO (MEO)	Voice, LS data, pos	Handheld, transportable, vehicular, maritime, aeronautical	1998-2000
ORBCOMM (Little LEO)	Data communications (2.4 kbps - 4.8 kbps), messaging, two-way paging, remote monitoring, pos (either Doppler or GPS)	Handheld, transportable, vehicular	1996

Key:
HS = high speed
LS = low speed (less than 9.6 kbps)
pos = positioning

4.3.3 Interoperability and Air-Interface Standards

The various systems to provide MSS are being developed independently of each other, without the benefit of a Standards Forum. At a meeting (February 1995) on MSS interoperability, organized by the Jet Propulsion Laboratories and NSA representatives, the commercial entities involved in the development and implementation of the MSS systems were reported to not be ready to discuss interoperability issues with each other at this point in time. It is, therefore, unlikely that there will be any direct interoperability between any of the systems which will be fielded in the next few years. All the systems supporting voice communications will, however, interconnect with the PSTN allowing connectivity to end users of other systems.

A number of systems providing MSS accommodate portable terminals that can access cellular radio systems as an alternative to connection through the satellite(s). As a rule, the MSS systems will operate on frequency bands which are separate from those allocated for cellular and emerging PCS systems, so a user of an MSS will require one of these dual-mode terminals in order to be able to connect directly to another competing wireless system. The majority of the systems providing MSS will use dual-mode terminals that will automatically attempt to complete a call request through a terrestrial wireless system before using the MSS capability.

While the systems providing MSS may not have "over-the-air" interoperability, the subgroup believes that the advantages of out-of-the-area communications and ubiquitous coverage achieved through systems providing MSS outweigh the direct interoperability limitations. There are other ways to achieve functional interoperability. For these systems, as well as many other wireless systems, the PSTN/PSDN will be the common standard interface. There should be no reason that users of one system could not communicate with users of another system. In some cases, an NS/EP appliqué that would have the same interfaces as the PSTN/PSDN could be used to provide the functional interoperability.

The subgroup is concerned, however, that the Government has no overall interoperability architecture for the use of MSS in supporting NS/EP functions.

4.3.4 End-to-End Compatibility

Different technologies used for MSS rely on different low-bit-rate voice processors, raising another interoperability issue: end-to-end compatibility. The MSSs which include voice services will permit interconnections through the PSTN, which relies on 64 or 32 kbps pulse code modulation (PCM) or adaptive PCM techniques. The connection through the PSTN is essentially transparent to the user, but there is a concern with regard to the intelligibility of an end-to-end voice connection between different MSSs. For example, could a government user of a system which utilizes a variable rate voice processor, communicate intelligibly through the PSTN with a user of another system which might utilize half-rate coding based on a different voice processing algorithm? Ongoing end-to-end compatibility tests are showing very poor performance, and there is concern about the impact of inherent delays in the satellite-based systems, including round-trip satellite and voice processor processing delays. The dual-mode terrestrial handset capabilities, data transfer rates, and voice encoding techniques for the several satellite-based systems are listed in Table 4.

While end-to-end compatibility is an inherent industry problem which should be resolved through the marketplace, it remains a potential concern for NS/EP users. In a disaster situation where the terrestrial communications are unavailable, NS/EP users might have extensive requirements for mobile-to-mobile communications. There is concern that the Government has no program underway to test and evaluate the end-to-end compatibility and to ensure that NS/EP communications needs will be met by these systems.

4.3.5 Transparency

Transparent network interworking is one of the Government objectives specifically identified as one of the DUITS requirements. It is expected that emerging wireless services will support applications that rely on existing wireline networks, such as the PSTN, ISDN, or packet-switched networks. These applications include G3 facsimile, STU-III, and point-of-sale transactions which are currently supported by V-series modems over the existing wireline networks. The Government requirement is for these services to be transparent to the user across the wireless access services and the intervening wireline networks. Network interworking may be necessary to support transparent operation of these applications through the emerging wireless access services, such as MSS. There is concern that the Government

Table 4. Air-Interface and Voice Characteristics

System	Access Type	Dual-mode Handset (Terrestrial mode)	Data Mode Rate	Voice Processor
INMARSAT(GEO)	FDMA	Not applicable	2.4 - 64 kbps	4.8 kbps (IMBE) - 16 kbps
MSAT (GEO)	FDMA	AMPS	2.4 - 4.8 kbps	4.8 kbps (IMBE)
Globalstar(LEO)	CDMA	AMPS, CDMA, TDMA	1.2 - 9.6 kbps	1.2 - 9.6 kbps CELP
Iridium (LEO)	TDMA/ FDMA	AMPS	2.4 kbps	4.8 kbps VSELP
Odyssey (MEO)	CDMA	AMPS, CDMA, TDMA	1.2 - 9.6 kbps	4.8 kbps
I-CO	TDMA	AMPS, TDMA	2.4 - 4.8 kbps	4.8 kbps

Key: AMPS = Advanced Mobile Phone System
CELP = Code-Excited Linear Predictive (coder/decoder)
FDMA = Frequency division multiple access
IMBE = Improved Multi-Band Excitation (coder/decoder)
TDMA = Time division multiple access
VSELP = Vector Sum-Excited Linear Predictive (coder/decoder)

has no program underway to evaluate the ability of MSS to support these devices and to develop, where appropriate, technical alternatives and interworking functions to support NS/EP communications requirements.

4.3.6 Security (Privacy)

Security (including privacy) is another one of the Government objectives specifically identified as one of the DUITS requirements. Government security requirements for systems providing MSS are important issues, and industry and Government should work together to address them. There are several aspects to the Federal security interests, including: confidentiality, integrity, authentication, availability, and accountability. Most of the Federal security requirements are the same as those which are important to the normal business user, although additional security requirements for Federal users have also been identified, such as maintaining confidentiality of the addressees. The Government objective is for wireless networks to support any user-provided security function (application-specific) transparently through the network. There is a requirement for using existing, analog based, STU-IIIs over the emerging wireless communications systems, to preserve the confidentiality of end-to-end communications. Further, there is a need to ensure that the next generation of STUs, digitally based STU III-Ds, are compatible with the emerging networks providing MSS.

The MSS providers are generally fully aware of the potential fraudulent use of their systems, based on the problems experienced by the cellular radio providers. Therefore, they are building their systems with mechanisms to provide both privacy and authentication capabilities.

The protection needs differ for many NS/EP users. Many, such as the medical community, may only need a good privacy system for the majority of their communications. Others, particularly those with national security responsibilities, require full security. Some users may also need end instruments that will allow different levels of security for individual calls. A particular concern is the physical size of current Government secure telephones, such as the STU-III, which does not lend itself to mobile operations as envisioned in emergency situations.

There is also concern that there does not seem to be an overall security/privacy architecture available for providing secure voice and data capabilities over emerging wireless technologies such as MSS. There should be a road map for both the Government and industry for security and privacy in the use of these systems.

Finally, there is concern about the export controls on some of the privacy systems. This could be a hindrance to NS/EP support capabilities where allied nations are involved.

4.3.7 Priority Access

Gaining access to a cellular radio channel during disaster situations has been shown to be a significant problem, therefore, industry and Government are working together to develop a cellular priority access service for NS/EP users. The Government, as previously recommended by the WSTF, should have a uniform, nationwide priority access for local, State, and Federal agencies during emergencies, when local wireless networks become congested. A nationwide approach was recommended to ensure effective implementation of the wireless priority treatment. There are a variety of different priority schemes available for the different systems providing MSS, but they are each unique in their designs, without any standard method for assignment or application, and they do not interact with the PSTN.

It is expected that priority access could be even more important in an MSS environment. There could be severe congestion with MSS in a disaster or crisis situation, as there are a limited number of communications channels. An approach similar to the PACA standard for cellular radio systems should be evaluated for MSS. The CPAS, based on the PACA standard, which is currently being promulgated for cellular systems, might be used as a guide for developing an MSS priority scheme. Since MSS relies heavily on the PSTN, there is a need for a priority scheme that not only provides access to the radio channel, but also ensures end-to-end service on a priority basis. The priority issue is a particular concern because there is no standards group currently addressing MSS. Priority for MSS could be the subject for further NSTAC investigation.

As an alternative to priority access, at least as an interim measure, the Government may want to reserve MSS capacity for day-to-day communications, as well as for NS/EP use in crisis and disaster support activities, without impacting commercial MSS.

4.3.8 Government Emergency Telecommunications Service Compatibility

There are a number of issues associated with MSS compatibility with the GETS, including priority access to radio channels as discussed above. The Government, however, needs to clarify its requirements for GETS compatibility with MSS. Specifically, the Government

should define the service desired, and the action an MSS would be required to take when a GETS user dials the 710 area code. GETS compatibility, and priority access and egress for MSS, are areas that the NSTAC might address further. An MSS specific service might be hypothesized that provides priority access to a radio channel, utilizes Signaling System #7 to provide priority treatment through the PSTN, and provides priority egress through the system providing the MSS.

4.3.9 New Service Offerings

A number of new service offerings are being made available through the emerging systems providing MSS. These include talk groups (conference net radio), position/location, broadcast, and direct terminal-to-terminal communications. In particular, the use of talk groups, or conference capability, is viewed as an important requirement for communications terminals supporting NS/EP activities, where a group of users, geographically separated, are engaged in a common goal or activity. This type of operation is typically available on LMR/SMR systems, used on the Department of Defense's ultra high frequency (UHF) satellite systems, and could be useful in NS/EP communications support provided by MSS. Position/location service, which could provide information on the exact location of each user, could have utility in NS/EP missions. Direct broadcast, where a common set of information is made available to all mobile NS/EP users, could also have value in providing status information on a disaster.

The use of these capabilities in the MSS selected to support NS/EP communications should be considered by the Government. The OMNCS should make these capabilities known to the members of the NCS, and should make the Government needs known to the MSS suppliers.

4.3.10 Reliability/Availability/Survivability

A potential concern with MSS is the reliability or availability of the service in disaster situations. For instance, the ground-entry points, or satellite ground stations, may be limited in number, placed in a vulnerable location, and have limited access to the PSTN. Further, the control channel from a ground station to the satellite for network control is a potential limiting factor. The ground entry points for the systems providing MSS are noted in Table 5. There is concern that some of the systems providing MSS may have only single ground stations without full backup and would be affected if the ground station is in the disaster area.

There is also concern about the access to gateways for MSS. Redundancy should be provided through diverse routing and backup systems. Redundancy of the ground station access might be provided through dedicated Government links to the ground stations. For instance, direct connectivity directly from the Federal Telecommunications System (FTS) 2000 or Defense Switched Network to the MSS gateway stations could be provided for enhanced accessibility.

Table 5. Ground Stations for Systems Providing MSS

System	U.S. Ground Station Locations	PSTN Access	Network control center(s)
INMARSAT (GEO)	Niles Canyon, CA Santa Paula, CA Southbury, CT Staten Island, NY	PSTN, PSDN, & private networks	London, England
OmniTRACS(GEO)	San Diego, CA	Not applicable	San Diego, CA
MSAT (GEO)	Reston, VA Alexandria, VA (RF terminal)	PSTN, PSDN, & private networks	Saddle Creek, CA
Globalstar (LEO)	9 in U.S.	Multiple gateways	6 worldwide
Iridium (LEO)	Multiple gateways	PSTN or private	2 in U.S.
Odyssey (MEO)	2 in U.S.	PSTN or private	2 in U.S.
I-CO (MEO)	2 in U.S.	PSTN, PSDN, & private networks	2 in U.S.
ORBCOMM (Little LEO)	NY, AZ, WA, GA	PSDN or private	Sterling, VA (multiple regional control centers)

4.3.11 FRP

Another issue of concern is the Federal guidelines for the use of communications, as covered in the FRP. In 1994, the WSTF recommended that the communications annex to the FRP, Annex 2 (ESF #2), be revised to "Encompass an 'all-hazards' approach making more effective use of wireless technologies and services." The use of the new emerging technologies, such as MSS, should be covered in ESF#2. The FRP, including pertinent annexes (e.g., ESF#2 - Communications, and ESF#8 - Health and Medical Services), should be periodically reviewed and updated to strengthen the consistent use of wireless services for NS/EP communications support.

4.3.12 International Coordination

The Government may be required to support NS/EP missions throughout the world. Many of the peacekeeping missions are being performed in countries where local (national) laws and regulations are observed. The MSS providers of global service have, or may have, operating agreements with foreign entities to allow them to provide service to countries around the world. It is not apparent, however, that these agreements would allow the Government to use MSS in performing NS/EP missions. It would be desirable for the Government to obtain the required agreements and licenses for NS/EP use of MSS in advance of any operational need.

The WSTF could consider the issue of whether or how the MSS operator agreements might be adjusted to accommodate global emergency response efforts.

4.3.13 Demonstrations, Training and Exercises

The use of these emerging MSS systems brings forth a new paradigm for NS/EP. The multiplicity of systems providing MSS with new capabilities and affordable pricing will provide the Government with voice, data and imagery services to meet NS/EP needs. However, as discussed above, there are still major issues that need to be resolved before the use of MSS can provide the full potential for NS/EP support. These issues should be resolved and the Government should take advantage of these new systems providing MSS. It is important to introduce these new technologies to the NS/EP users through demonstrations, training, and exercises. The NCS should be moving to take advantage of these new systems. Although the OMNCS has developed a plan for some experiments, we believe that the scope of the effort should be expanded. Specifically, the Task Force believes that the OMNCS should produce a comprehensive plan that would involve all members of the NCS in demonstrating, training, and exercising with MSS alternatives to support various NS/EP scenarios. The NCS should have an aggressive program to test and evaluate service offerings to take full advantage of the capabilities that the MSS offers.

4.4 RECOMMENDATIONS

This initial scoping effort determined that many systems providing MSS are currently available. There will soon be more capabilities, and within the next three or four years there will be a proliferation of providers of MSS. This effort also determined that there is a need for this service for NS/EP communications support. However, there are deficiencies that need to be overcome to ensure that MSS can fulfill NS/EP needs.

This scoping effort determined that there are numerous areas that need to be addressed by the Government as soon as possible, since there is such a long lead-time in the development of systems which can provide MSS, and plans are currently being crystallized for these systems. The areas that should be addressed include the following items.

1. Development of an MSS interoperability architecture
2. A program to test end-to-end interoperability
3. A program to test transparency and develop alternatives
4. Development of an MSS security architecture
5. Development of an MSS priority access capability
6. Determination of NS/EP users' needs, including new services
7. A program to address the reliability and access of MSS gateways
8. An effort to review and update, as required, ESF #2 and other ESFs, with the focus on MSS

9. An effort for achieving international agreements for the use of MSS for NS/EP

10. Establishment of a program for demonstrations and exercises using MSS

The following issues, related to the use of MSS for NS/EP support, are candidates for future NSTAC efforts.

1. Determine the need for standards for voice and data over systems providing MSS, and the mechanisms to achieve industry consensus.

2. Identify requirements for including security interfaces in MSS equipment.

3. Propose a priority access methodology for MSS use which is in concert with cellular priority access service.

4. Explore interactions of GETS and the use of MSS for NS/EP communications support.

SECTION 5

PERSONAL COMMUNICATIONS SERVICE

5.1 PCS TECHNOLOGY OVERVIEW

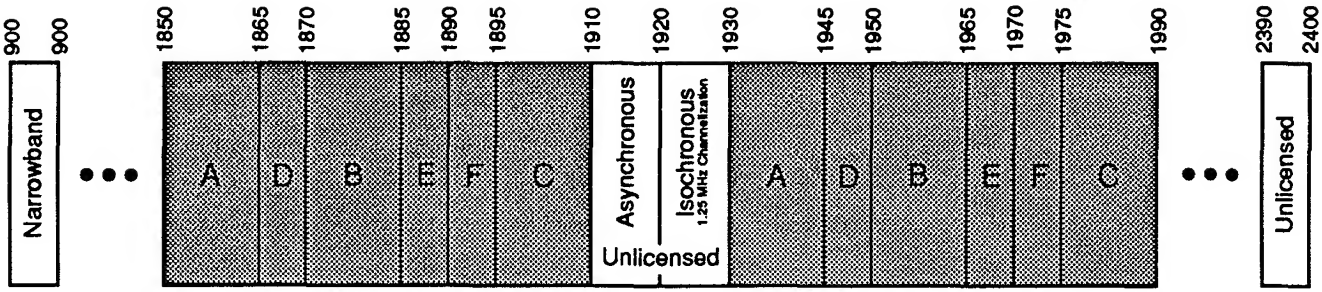
PCS is an emerging telecommunications concept currently in the development and early implementation stages. Ambiguities exist in the definition of PCS because of the lack of agreement among members of the Government/industry community on exactly what PCS is, and the number of diverse approaches and initiatives under consideration for providing model capabilities. The FCC defined PCS as: "A family of mobile or portable radio communications services for individuals and business, that may be integrated with a variety of competing networks [2]." The Standards group T1P1 [3] has proposed a definition of PCS as: " - a set of capabilities that allows some combination of terminal mobility, personal mobility, and service profile management," and defined a PCS system as: "- a collection of facilities which provide some combination of terminal mobility, personal mobility, and service profile management."

Generally, it is the industry consensus that with PCS the emphasis will be on providing communications on a person-to-person basis rather than via the station-to-station mode of operation provided by most current telecommunications networks. Implementation of PCS will probably require that each individual having access to PCS be assigned a personal number. When fully deployed in mature configurations, PCS is expected to provide users with freedom from the constraints of wireline access to the PSN by providing direct connectivity to and from the PSN from diverse locations for different applications, via a single small portable telecommunications device. PCS is expected to support wireless connections to Private Branch Exchanges (PBXs), Local Area Networks (LANs), mobile public telephone service, facsimile service, and other connectivity for various voice and data applications as was illustrated in Figure 1.

The FCC has allocated spectrum at 2 GHz for PCS, including 120 MHz of spectrum for licensed broadband PCS, and 30 MHz for unlicensed PCS devices, as well as 3 MHz of spectrum at 900 MHz for narrowband PCS. The spectrum allocation is illustrated in Figure 2. PCS is considered by some to be the next generation of cellular at a higher frequency range, and cellular providers are currently in the process of converting to digital cellular systems, which will provide capabilities similar to those being promised through PCS.

The PCS Subgroup addressed the broadband PCS, which is expected to primarily provide wireless voice, as well as data, communications through radio coverage of geographic areas divided into microcells, i.e., small areas of coverage to permit the use of low power devices and frequency reuse.

The FCC recently auctioned several of the frequency bands for wideband PCS, which will lead to a series of mobile voice services options for NS/EP support. The wideband PCS licensees include Ameritech, AT&T Wireless, BellSouth, GTE Macro Communications, Pacific Telesis Mobile Services, PCS Primeco (AirTouch, Bell Atlantic, NYNEX, US WEST), SBC Communications, and Wireless Co. (Sprint, TCI, Cox Cable Communications). Pioneer



	Block	Spectrum	Area	Frequency (MHz)
Broadband	A	30 MHz	MTA	1850-1865/1930/1945
	B	30 MHz	MTA	1870-1885/1950-1965
	C	30 MHz	BTA	1895-1910/1975-1990
	D	10 MHz	BTA	1865-1870/1945-1950
	E	10 MHz	BTA	1885-1890/1965-1970
	F	10 MHz	BTA	1890-1895/1970-1975
Unlicensed	Asynchronous	10 MHz		1910-1920
	Isochronous	10 MHz		1920-1930
	Asynchronous	10 MHz		2390-2400
Narrowband		3 MHz		900-901/930-931/940-941

Figure 2. PCS Channel Plan

preference licenses have been set aside for Omnipoint, Cox Enterprises, and American Personal Communications. Additional auctions for frequency allocations for designated entities are planned for later this year.

The SMR providers are also implementing new digital systems which have integrated voice/data capabilities. Currently, these systems are limited to a few geographic areas, although a few service providers have announced plans to expand their networks across the nation, and could eventually compete with PCS and cellular systems.

This proliferation of different digital wireless services, including PCS, cellular radio, SMR, and MSS, could cause confusion during disaster responses and delay or inhibit the provision of services to NS/EP users, unless the Government has a coherent plan for utilizing these new emerging technologies and services.

5.2 PCS ISSUES

A number of potential issues concerning the NS/EP use of PCS were discussed, as summarized below. A major concern, with respect to possible WSTF recommendations and follow-on actions, however, was a lack of understanding of the planned use of PCS by the Government to support NS/EP users.

5.2.1 Proliferation of Local PCS Service Providers

The members concluded that there will be two types of service providers for PCS, based on the auction process of the FCC for wideband PCS licenses. One group will comprise major telecommunications companies, or consortiums, which will provide service on a regional or national basis. The other group will include companies which meet the FCC guidelines for small business. The regional PCS licensees will likely have been involved in NS/EP efforts in the past and have substantial knowledge of NS/EP processes, allowing them to be able to easily incorporate basic NS/EP planning into their network operations. However, it is expected that the other group, primarily local PCS providers, will have little or no understanding of NS/EP telecommunication functions. Therefore, the Federal Government and private industry should work together to educate these new PCS service providers about the importance of maintaining state-of-the-art NS/EP capabilities.

5.2.2 Unlicensed PCS

Unlicensed PCSs, including wireless PBXs and wireless local area networks were discussed. The group concluded that while unlicensed PCSs would be useful in NS/EP command and control environments, there is no need for priority on self-contained systems, such as PBXs, and no need for further investigation of these services.

5.2.3 Federal Procurement Plans

The members discussed Federal telecommunication procurement initiatives and supported the Government's requirements for DUITS wireless services. It was noted that the Government is no longer interested in owning wireless communications equipment and that the FWPC is

working to establish a leasing strategy for future wireless service procurements. The subgroup agreed that the Government should work to maximize purchasing flexibility so that it could procure services from the best qualified vendor as wireless technologies advance. In that way, the Government could avoid purchasing equipment for PCS that might soon become outdated, although recognizing that leasing charges are normally designed by the service provider to ensure recouping the cost of the equipment.

5.2.4 Interoperability and Air-Interface Standards

The subgroup discussed the several different air interface standards that have been proposed for PCS. Although the NS/EP user community should be cognizant of industry's effort to finalize PCS technical standards, the subgroup agreed that it was more important for the Government to make cost-effective procurement decisions. The subgroup agreed that air-interface standards would ultimately be determined by the marketplace and that the Government should recognize it as a near-term problem and be prepared to deal with it through the procurement process. The Federal Government must be prepared to lease or buy multi-mode wireless phones that are capable of supporting NS/EP operations. Another possible solution discussed is for the Government to enter short-term contingency contracts with existing wireless service providers.

5.2.5 End-to-End Compatibility

The subgroup discussed the issue of end-to-end compatibility between different PCS technologies, which rely on different, low bit rate voice processors. For example, could a Government user with a CDMA phone with variable rate voice processor communicate intelligibly with a user with a TDMA phone operating with a half-rate coder with a different voice processing algorithm? Further, will PCS implementations permit the use of Government-owned secure-voice terminals? The subgroup agreed that end-to-end compatibility is an inherent industry problem that will eventually be resolved in the marketplace.

5.2.6 PCS, Cellular, and Satellite System Compatibility

The subgroup discussed the possibility that a multimode phone would be developed to provide contiguous service in different network environments including PCS, cellular radio, and MSS. It was agreed that the issue might be resolved through a Government lease of wireless handsets, rather than purchasing handsets. Leasing would maximize the Government's purchasing flexibility and enable it to upgrade its wireless communication capabilities as wireless technologies progress.

5.2.7 Priority Access

Gaining access to a cellular radio channel during disaster situations has been shown to be a significant problem. Therefore, industry and Government are working together to develop a cellular priority access service for NS/EP users. It is expected that priority access will also be required in a PCS network environment. The subgroup agreed that while PCS priority access was not an immediate concern, it was an issue that should be dealt with as the industry continues to grow. A member noted that PCS networks might be deployed gradually,

beginning with macrocells and eventually including microcells. The same member suggested that there could eventually be a congestion problem with PCS networks, not in terms of accessing voice channels, but in terms of accessing the PSTN. The subgroup agreed that something similar to the PACA standard should be deployed for PCS networks. It is understood that the PACA standard agreed for cellular systems is also being considered for PCS networks. Additionally, the subgroup agreed that future PCS priority access standards should also consider issues associated with switch congestion, as well as congestion in voice channel access.

5.2.8 Government Emergency Telecommunications Service Compatibility

The subgroup discussed issues associated with PCS compatibility with the GETS. The subgroup agreed that the Government needs to clarify its requirement for GETS compatibility. Specifically, the Government should define the service desired when a GETS user dials the 710 area code. Several other GETS compatibility questions were posed, including how the Signaling System Number 7 (SS7) would be used in a GETS environment and what services would be supported Additionally, the subgroup discussed the possibility that SS7 could support NS/EP priority egress in a GETS environment. The subgroup agreed that priority egress would be counterproductive to NS/EP operations because it could cause significant congestion in the wireline portion of the network.

The subgroup identified this area as one which the NSTAC might productively address. In particular, it was suggested that the WSTF might hypothesize a specific PCS application that utilizes SS7, e.g., combining priority access, wireline priority treatment, and priority egress.

5.2.9 Security

The subgroup agreed that the Government must define specific security requirements so that PCS service providers would be able to provide end-to-end encryption. Industry and Government should work together to ensure that the third generation of digital STUs, would be compatible with emerging PCS networks. The Government needs for security are recognized, but the subgroup does not foresee any need for WSTF action in this area.

Note that verification, authentication, reliability, and survivability were each considered and discussed as possible issue areas, but were dismissed because the commercial market is expected to demand an adequate level for these capabilities.

5.3 PCS RECOMMENDATIONS

The use of PCS for NS/EP support is an area the Government is just beginning to address. This initial scoping effort determined that there is a proliferation of potential service providers for PCS. However, since it is such a broad area, the capability of the WSTF to focus on specific issues requires that the Government provide information regarding the planned use of the emerging PCS for NS/EP telecommunications support. Therefore, the WSTF recommends that the FWPC and the FWUF address this area in their deliberations, and return to NSTAC with particular problems for consideration.

One area identified for consideration for potential future NSTAC work is the possible investigation of priority treatment for NS/EP users of PCS.

SECTION 6

WIRELESS MOBILE ACCESS TO DATA NETWORKS

6.1 MOBILE WIRELESS DATA OVERVIEW

The Federal Government is interested in obtaining mobile wireless access to data services in support of NS/EP operations which appear to the user to be universally interoperable and available using common devices.

Mobile wireless access to data networks is defined as a communications capability providing a mobile data terminal user with access to a data network via wireless means from unspecified locations. Wireless data communications services include data transfer capabilities from wireless terminals similar to those available to non-wireless data terminal equipment over land lines. These services typically employ the standard X.25 interface protocol for connection to X.25 public data networks. In one configuration currently in use, information entered by users at originating wireless terminals is transmitted over a national packet-radio network to a network end station where it is then transmitted by the end station to the designated receiving terminal. Terminals can be anything that connects to an X.25 network, from a keypad and display to a laptop computer, pocket computer, or handheld terminal.

Wireless data communications networks are designed for short, bursty interactive data transmission. In addition, they can accommodate multiple host connections and have a store-and-forward capability. There are several companies that currently supply wireless X.25 data services in competition with data services available through cellular radio systems. Currently, wireless data systems are also being implemented which include a capability to support Transmission Control Protocol/Internet Protocol (TCP/IP).

Another type of service is provided by wireless local area networks (WLAN). WLAN is a LAN in which connectivity is provided by radio (as opposed to wire), permitting the interconnection and communication between a group of computer workstations, primarily for the sharing of resources such as data storage devices and printers. WLANs cover short distances (generally less than 1 kilometer), usually within a single building complex. Different data transfer rates are possible and shared centralized data storage access may be provided.

There are a multitude of existing and emerging services which might be used to provide mobile access to data services for NS/EP support, as was illustrated in Figure 1. Currently, the typical method to provide mobile wireless access to data networks or information systems is through analog-based cellular systems which can be used to provide circuit-switched access through a modem attached to a cellular telephone, or through a radio equipped with a modem. Data rates of up to 14.4 kbps are possible with enhanced modems for radio applications. Another method being implemented to carry data over cellular systems is through cellular digital packet data (CDPD). CDPD makes use of the unused capacity of the cellular system by inserting packets of data in idle voice channels, or reserved channels. CDPD is being promulgated by the cellular service providers and is in the process of implementation across the nation. CDPD operates at 19.2 kbps, but throughput is limited to less than 14 kbps due to overhead data necessary to provide reliable data transfer over the air. Standards organizations are also

working on developing standards for data transmission over the emerging digital cellular systems, both TDMA- and CDMA-based systems.

There are currently two existing "nationwide" mobile packet data service providers, Ram Mobile Data and Ardis. These service providers have extensive coverage across the nation and their systems operate at data rates between 8 and 19.2 kbps, with throughput from 2 to 8 kbps. Ram uses the Mobitex standard developed by Ericsson AB, while Ardis uses a proprietary protocol developed by Motorola and IBM, so the hardware designed for one network will not work with the other.

Last year the FCC auctioned several frequency bands for narrowband PCS, including both national and regional licenses, which will lead to another series of mobile wireless data access possibilities. The narrowband PCS licensees include PageMart, PCS Development, MobileMedia PCS, Advanced Wireless Messaging, AirTouch Paging, Lisa-Gaye Shearing, Insta-Check Systems, Ameritech Mobile Services, and Benbow PCS Ventures. At least one service provider plans to launch a narrowband service with a throughput of up to 25 kbps. It is anticipated that the new services will include mobile wireless access for laptops with Personal Computer Memory Card International Association (PCMCIA) card adapters, personal digital assistants (PDAs), and paging devices capable of receiving and sending short messages.

The FCC has also authorized frequency spectra in multiple bands for unlicensed device operation. These bands will be used by low power devices and will include operation of WLANs and wireless PBXs, which will find use in support of disaster field offices and/or medical support facilities.

SMR providers are also implementing new digital systems which have integrated voice/data, fleet dispatch, and paging capabilities. Currently, these systems are currently limited to approximately 4.8 kbps throughput, and available in only a few areas, although service providers have announced plans to expand their networks across the nation.

There are also numerous mobile satellite services being proposed for deployment, utilizing a variety of different technologies. For example, in October 1994, the FCC granted a license to a company to build and operate a little LEO system. The LEO system is being planned to provide store-and-forward message capability in support of both handheld and vehicle-mounted mobile terminals.

6.2 DISCUSSION

Wireless interoperability for wireless data can be defined as the capability to communicate between two given terminals or systems, at least one of them utilizing a wireless access method, over a variety of facilities without the user needing specialized adapters or operating procedures. Wireless data interoperability can be addressed at different interface points and for different services. Interfaces of concern include the user service/application terminal-to-mobile radio terminal interface, the air interface, the radio base station-to-mobile switch terminal interface, the mobile switch-to-landline switched network interface, and the landline network-to-terminal or data service interface. Wireless data services for NS/EP use could include packet-switched data, circuit-switched data, facsimile, location/position determination, and

paging, as well as STU-III-D connections. As noted above, these wireless data services might be provided through a multitude of different systems, including: cellular radio, PCS, SMR, mobile satellite systems, wireless data networks, and paging networks. When a wireless service connects an NS/EP user terminal to another user terminal, or service, through a land-line switched network, a number of different networks may be involved, such as the PSTN, PSDN (including the Internet), the Defense Information System Network, or the FTS 2000.

The FWPC requirements statement identifies the need for terminal mobility, with service availability regardless of geographic location, the function being served, or the network being utilized. When responding to an emergency situation, the NS/EP user requires the use of a terminal device for a given service or application function, regardless of where the emergency occurs. Transparency is an implied feature of interoperability. Transparency implies that user actions remain the same, regardless of the geographic location or intervening networks, and the techniques or mechanisms used to provide the particular wireless service do not require that the Government user know the details of the underlying technologies. As an example, there are a number of data transfer mechanisms available for cellular radio systems, each with its own capability for interoperability. In the case of existing analog cellular radio systems, a modem can be used to connect a computer directly to a cellular telephone, achieving a circuit-switched data connection through the PSTN. In digital cellular systems, however, special interworking functions must be provided by the cellular carrier, or value-added server, to achieve such a service through the PSTN. Further, CDPD is currently being deployed and will accommodate packet data services. In all three of these cases, however, the user must use different equipment, hardware and software, to connect to the cellular system, potentially limiting the roaming capability of the NS/EP user.

6.3 MOBILE WIRELESS DATA ISSUES

A number of potential issues concerning the NS/EP use of mobile wireless access to data services were discussed, as summarized below. A major concern, with respect to possible WSTF recommendations and follow-on actions, however, was a lack of understanding of the planned use of mobile wireless access to data services by the Government to support NS/EP users.

6.3.1 Proliferation of Wireless Data Service Providers

There are numerous service providers currently offering, or planning to offer, mobile wireless access to data networks. These include the existing cellular providers, existing mobile data service providers, service or equipment providers for the unlicensed frequency bands set aside for data applications, narrowband PCS licensees, SMR service providers, and the MSS entrants. It also includes companies that will be bidding on the narrowband PCS frequency allocations for designated entities, which may be entering the telecommunications business for the first time. The new service providers may not be familiar with NS/EP programs and telecommunications functions. Therefore, the Federal Government and private industry must work together to educate these new service providers with respect to maintaining NS/EP capabilities.

6.3.2 Interoperability

There are a number of interoperability issues arising from the introduction of new technologies in emerging mobile wireless data access systems with a variety of air-interface techniques and network interfaces. The emergence of so many different systems, most based on different designs, makes it very difficult for the Government to ensure that equipment obtained to support NS/EP functions will be interoperable. However, end-to-end compatibility, necessary for voice terminals may not be as critical in mobile wireless data, since most mobile wireless data communications are expected to be between a terminal and a database or server, rather than terminal-to-terminal. Whether or not interoperability is a problem for NS/EP users will depend on the Government plans for utilizing these new services. However, without standards being developed and implemented, including service descriptions, there is concern about the availability of mobile wireless data services to support Government NS/EP requirements.

6.3.3 Priority Access

Gaining access to a cellular radio channel during disaster situations has been shown to be a significant problem, therefore, industry and Government are working together to develop a cellular priority access service for NS/EP users. In recent disasters, wireless access to data networks has proven to be reliable and survivable, while experiencing some local congestion. However, because of the limited experience and use of data networks for NS/EP functions, it is unclear whether wireless access to these networks during disasters will be a problem, and further investigation may be warranted.

6.3.4 CDPD Availability

In the case of CDPD, there is an issue of availability of the service in times of stress, since CDPD relies on the availability of unused frequencies in the cellular radio band. In theory, CDPD should function, even when the network is fully loaded, because it uses idle channels between calls. However, the throughput can be significantly degraded in disaster situations, especially when priority calls are in queue, since that means the cell serving that area is fully loaded with voice calls. Therefore, there is a concern that CDPD would not be available at the times it is needed to support emergency situations.

6.3.5 Security

Security is certainly a concern for NS/EP users. However, additional information concerning the NS/EP use of mobile wireless data communications services is needed before NSTAC can identify which wireless security issues to address.

6.3.6 Unlicensed PCS

As noted above, the FCC has authorized the operation of unlicensed services/devices in designated frequency bands. Some of the facilities utilizing this option are wireless LANs and wireless PBXs. It is likely that emergency response centers will use these wireless data systems in support of disaster response operations. Wireless LANs, for example, are easier to set up on-the-fly and are more easily transportable than wired LANs. However, no specific

issues were identified for the WSTF to address in this area that are different from those noted for licensed wireless data communications.

6.4 MOBILE WIRELESS DATA RECOMMENDATIONS

The use of mobile wireless access to data facilities for NS/EP support is an area the Government is just beginning to address. This scoping effort determined that there is a proliferation of potential service providers of mobile wireless data services. Some of these providers have proprietary systems which are not interoperable with any others, while some utilize standard systems that allow a user to connect to systems of multiple service providers. It was noted that this is a growing, complex area, and there are a number of potential issues arising from the use of mobile wireless access to data networks/services. However, since it is such a broad area, the capability of the WSTF to focus on specific issues requires that the Government provide information regarding the planned use of the emerging wireless data networks for NS/EP telecommunications support. Therefore, the WSTF recommends that the FWPC and the FWUF evaluate current and planned uses of wireless data technologies, including any specific problems they would like addressed, and provide the NSTAC with that information for consideration.

SECTION 7

CONCLUSIONS

The Task Force has completed its scoping task and has concluded that these emerging wireless technologies could provide significant capabilities to NS/EP communications support. It has identified a number of areas that need further work by both Government and industry entities and has provided recommendations for resolution by the Government. These recommended actions address areas where the NSTAC could assist the Government. However, in most of these cases, the Government priorities are not clear to the Task Force. When Government priorities have been established, the NSTAC should be called upon by the Government to assist in their resolution, as appropriate.

The Task Force Subgroups came to a number of conclusions from the issues considered. Some of these conclusions apply to all the emerging technologies, such as concerns over priority access for NS/EP users, low-bit-rate voice processor compatibility, and the proliferation of service providers unfamiliar with NS/EP concerns. Other conclusions were technology-specific, such as concerns over MSS gateway security and congestion at PCS switches.

As a highlight, it was concluded that MSS has an advantage for certain NS/EP uses, as it provides "out-of-the-area" communications over long distances and on a global basis. MSS has the ability to deliver a range of services in regions lacking adequate terrestrial telecommunications because of location, results of a disaster, or lack of reliable terrestrial infrastructure. MSS removes NS/EP users' dependence on the local telecommunications infrastructure, while allowing operation with the local facilities when they are available, through connections made through a satellite ground station and the PSTN/PSDN.

The implementation of the NPR-IT04 National Law Enforcement/Public Safety Network is expected to provide law enforcement and public safety an integrated wireless, wireline network that meets the functional requirements of the NS/EP user community. As envisioned, the network will incorporate spectrally efficient technologies, support interoperability, enhance the safety of law enforcement/public safety personnel, and be secure. Network planning and development will be sensitive to individual agency issues such as priorities and privacy, will provide virtual autonomy and non-interfering operations, and will include flexibility to expand and extend capabilities. Cooperative and coordinated system development efforts between multiple agencies will relieve the effects of diminishing resources such as funding and radio spectrum and will result in numerous cost and quality-of-service advantages. This network will provide NS/EP telecommunications and can be interconnected to an MSS user via a gateway.

Based on its review of the issues involving emerging wireless services, the Task Force came to the conclusions described in the following paragraphs for some of the important issues discussed by the several subgroups.

1. Multiple Service Providers/Ubiquity

   The rapid introduction of new service providers and new capabilities has both positive and negative aspects. The availability of these new systems and capabilities means that the NS/EP users will have multiple systems to choose from in selecting the telecommunications to serve various NS/EP functions. However, it also means there is an urgent need for more coordinated planning due to these multiple providers and new services becoming available. It now becomes even more important that the many NCS organizations coordinate their efforts to accommodate the wide variety of potential NS/EP support missions, and the multitude of existing and emerging wireless capabilities available. It was concluded that with the proliferation of new service providers, some will have little or no understanding of NS/EP telecommunications functions, and a need to educate these new service providers is anticipated.

   A related concern with the proliferation of service providers is the ubiquity of service across the nation. This arises from the need for NS/EP users to move to a disaster site which is far removed from their normal location. In the case of LMR, for example, there are a few Federal systems which have frequency allocations across the entire nation. However, these frequency assignments are generally given to designated groups on a regional basis and controlled locally, so there is limited capability for users in one area to travel to another area and still be able to use their LMR terminal units. It was concluded that the Government should address the functional requirements for a gateway to provide interoperability between systems, and evaluate the spectrum utilization for its impact on future communications support for emergency response efforts.

2. Interoperability

   The Government need for interoperability, and the potential of multiple air interface standards has been recognized for some time as a problem. The issue was discussed in all four scoping subgroups. The problem of interoperability already exists with LMR systems used for NS/EP functions, and it is expected to be a problem with the other emerging wireless services (MSS, PCS, and mobile wireless data). In the case of MSS, it is unlikely that there will be any direct interoperability between any of the systems which will be fielded in the next few years. The emergence of so many different systems, most based on different designs, makes it very difficult for the Government to ensure that equipment obtained to support NS/EP functions will be interoperable. It was generally agreed, however, that air-interface standards would ultimately be determined by the marketplace. The Government should recognize it as a near-term problem and be prepared to deal with it through the procurement process. Note that in October 1994, the Task Force issued a report on interoperability, which provided a number of suggestions for Government actions to alleviate interoperability concerns with the use of emerging wireless systems for NS/EP support.

3. End-to-End Compatibility

The proliferation of emerging wireless systems raises the issue of end-to-end compatibility. While connection of users through the PSTN is essentially transparent to the user, there is concern with regard to the intelligibility of a voice connection between different wireless access systems, when the two wireless access techniques rely on different, low-bit-rate voice processors. In a disaster situation, NS/EP users might have extensive requirements for mobile-to-mobile communications. It was concluded that end-to-end compatibility is an inherent industry problem that will eventually be resolved in the marketplace, but the Government should be cognizant of the problem and take the necessary steps, including close cooperation between NCS agencies, to prevent interoperability problems through the procurement process.

4. Reliability/Availability

The Task Force is concerned with MSS systems reliability or availability of the service in disaster situations. The ground entry points may be limited in number, placed in a vulnerable location, or have limited access to the PSTN. Some of the MSS systems may have only single ground stations without full backup, and would be adversely affected if the ground station is in the disaster area. It was concluded that redundancy of ground station access should be provided through diverse routing and backup systems, including dedicated Government links to the ground stations for enhanced accessibility.

5. Priority Access

The need for priority access for cellular systems has been demonstrated numerous times, as noted earlier. It is also a concern for the emerging wireless services and was addressed by all the Task Force Subgroups. If the Government acquires SMR services from a commercial entity, priority access becomes an issue for NS/EP users of this service in disaster recovery operations. It is also anticipated as a problem for MSS in support of NS/EP users, since there is only a limited number of channels available to serve the entire nation. Further, the MSS relies heavily on the PSTN, so there is a need for a priority scheme that not only provides access to the radio channel, but also ensures end-to-end service on a priority basis. In the case of PCS and mobile data access, the impact or need for priority is not as clear. For instance, with the introduction of many small radio cells for PCS, the channel access limitation may be moved from the air interface into the PSTN itself, or to the access into the PSTN. Therefore, it was concluded that, with respect to the emerging wireless services, there is a need to further examine priority access needs and options, similar to the ongoing, joint Government-industry investigation into establishing a cellular priority access service for NS/EP use.

In the case of mobile wireless data access, there is an issue of availability of a particular data access service in times of stress, namely CDPD, since it relies on the availability of unused frequencies in the cellular radio band. In theory, CDPD should function, even when the network is fully loaded, because it uses idle channels between calls. However, the throughput can be significantly degraded in disaster situations, especially

when priority calls are in queue, since that means the cell serving that area is fully loaded with voice calls. It was concluded that CDPD should not be relied upon to support emergency situations, but other service options should be evaluated to support NS/EP user data communications requirements.

6. Security

There are several aspects to the Federal security interest, including: confidentiality, integrity, authentication, availability, and accountability. The Task Force recognizes that the protection needs differ for many NS/EP users. Many, such as the medical community, may only need a good privacy system for the majority of their communications. Others, particularly those with national security responsibilities, require full security, perhaps even to the compartmented level. One specific Government objective is to utilize wireless networks to support each NS/EP user-provided security function (application-specific) transparently through the network. A related concern of the Government is the use of existing, analog-based, STU-IIIs over the emerging wireless communications systems, to preserve the confidentiality of end-to-end communications. Further, there is a need to ensure that the next generation of secure telephone units, digitally based STU-III-Ds, are compatible with the emerging networks. The Task Force concluded that there should be a "road map" for both Government and industry for security and privacy in the use of these emerging wireless services for NS/EP support.

7. GETS Compatibility

A number of issues associated with the compatibility of GETS with both cellular radio systems and the emerging wireless services were identified. The compatibility and the interoperation of priority access schemes for the over-the-air interface and the wireline networks was a central theme in all the subgroup discussions. It was concluded that the Government needs to clarify its requirements for GETS compatibility. Specifically, the Government should define the priority services desired, and any need to transfer GETS-related signals directly to the wireline service provider when a GETS user dials the 710 area code in a call request. It was also concluded that GETS compatibility with priority access and egress for emerging wireless systems is an area that should be explored further.

8. Federal Response Plan

Another issue of concern is the Federal guidelines for the use of communications, as covered in the FRP. In 1994, the WSTF recommended that the Communications Annex to the FRP, Annex 2 (ESF#2), be revised to "Encompass an 'all-hazards' approach making more effective use of wireless technologies and services." The use of the new emerging technologies, such as MSS, should be covered in ESF#2. The FRP, including pertinent annexes (e.g., ESF#2 - Communications, and ESF#8 - Health and Medical Services), should be periodically reviewed and updated to strengthen the consistent use of wireless services for NS/EP communications support.

9. Coordination/Planning/Procurement

The Task Force concluded, as noted above, that there is an urgent need for more coordinated advanced planning due to the multitude of providers and new emerging wireless services becoming available. It is now even more important that the many NCS organizations coordinate their efforts to accommodate the wide variety of potential NS/EP support missions, and the multitude of existing and emerging wireless capabilities available.

In the case of LMR/SMR, utilization is reduced in part due to disparate radio frequency allocations by the FCC and NTIA/IRAC, and the limited frequency agility capability of existing equipment. Frequency coordination and allocation processes should be evaluated, as well as procurement practices to ensure maximum use of available wireless facilities. This endeavor could be coupled into the future efforts of the FCC/NTIA advisory committee, and set up to address frequency spectrum for public safety and law enforcement entities.

The Government has initiated a process for obtaining uniform wireless services through an Request for Comment (RFC) issued by DITCO, but there is still concern that the full extent of the emerging wireless services are not being sought for NS/EP users, since the initial RFC does not specifically include MSS. In the case of MSS, which is important in communicating with NS/EP users at inaccessible locations, it may be useful for the Government to consider reserving capacity for day-to-day communications, which could then be preempted for NS/EP use in crisis and disaster support activities. It was concluded that the Government does not have an overall architecture for the use of MSS systems in support of NS/EP, which should cover, among other things, interoperability requirements.

The Government may be required to support NS/EP missions throughout the world, where local (national) laws and regulations are observed. It was concluded that the Government should be coordinating with other Governments and international bodies to obtain the required agreements and licenses for emerging wireless communications, particularly MSS, to support global emergency response efforts, in advance of any operational need.

10. Regulatory Issues

There were a number of regulatory activities which arose during the Task Force deliberations. It was concluded that CPAS would require approval by the FCC, including authorization of the criteria for precedence levels and their assignment, based on the NS/EP user's functions, mission, and needs. The potential impact of the FCC's wireless 9-1-1 docket on CPAS implementation was also noted, and activities on this docket should continue to be monitored.

The LMR/SMR Subgroup also noted that the FCC is taking actions which might affect the use of VHF/UHF spectrum for NS/EP users. The FCC is promulgating the reduction of channel bandwidth from 25 kHz per channel, through a transition of 12.5 kHz per channel, and eventually migrating to 6.25 kHz over the next several

years, which would impact the procurement plans of Federal and public safety users. The FCC is also considering additional designation of contiguous segments of bandwidth in the 800 MHz band for licensed SMR use. This would require relocation programs which might also impact NS/EP users. It was concluded that the Government should closely monitor the regulatory actions in this area, as they could have direct impact on procurement programs for NS/EP communications systems.

11. Standards

A number of standards issues were identified concerning existing and emerging wireless services. Extensive efforts have resulted in specifications for a conventional air-interface for non-trunked LMR systems to provide radio compatibility between next-generation conventional, digital, LMR radios, but these do not address the interoperability needs for the digital trunked radio systems that are being developed for commercial applications.

In the case of MSS, the various systems are being developed independently of each other, without the benefit of a Standards Forum. It is unlikely, therefore, that there will be any direct interoperability between MSS systems which will be fielded in the next several years.

For PCS, multiple air-interface standards have been proposed, and several are being, or about to be, approved. It was concluded that the Government should work to maximize its purchasing flexibility so that it can procure services from the best qualified vendor as wireless technologies advance, without purchasing equipment that might soon become outdated.

There are numerous service providers offering, or planning to offer, mobile wireless access to data networks. A number of these mobile data access systems include proprietary system designs, making it difficult for the Government to ensure that equipment obtained to support NS/EP functions will be interoperable. However, it was concluded that end-to-end compatibility, necessary for voice systems, may not be as critical for mobile wireless data applications, since most wireless data communications are expected to be from a mobile terminal to a host server and associated database, rather than terminal to terminal. It was noted, however, that without standards being developed and implemented, there is concern with the availability of uniform mobile wireless data services for NS/EP users.

12. CPAS

The WSTF CPAS Subgroup continued to pursue a nationwide cellular priority access service, which is a call-by-call mechanism that provides priority handling of NS/EP call attempts. The Task Force reaffirmed the conclusions that:

- A uniform, nationwide, ubiquitous CPAS capability would benefit Federal, State, and local NS/EP users, and appears feasible in the near future.

- Industry and Government have successfully addressed many issues that are necessary for CPAS implementation, although technical, administrative, and regulatory issues remain.

- Continued government and NSTAC involvement in support of the CPAS implementation process is important, as is continued inclusion of a wide array of CPAS stakeholders in the implementation process.

Finally, the Task Force concluded that:

- NS/EP telecommunications capabilities could benefit from a joint industry-Government investigation of the use of new wireless technologies in NS/EP operations. While the industry members on the task force identified a number of issues for consideration, the joint industry-Government process would focus both parties' efforts on the most important issues, and allow both Government and industry to move forward in addressing the most critical problems.

- It would be beneficial for Federal, State, and local representatives to collaborate on NS/EP issues involved in new and evolving wireless technologies. Because NS/EP telecommunications involve a range of environments, users, and requirements, an adequate cross-section of users — including representatives from the distinct areas of national security and emergency preparedness — is necessary for effective consideration.

- The efforts of the OMNCS to update ESF#2 of the Federal Response Plan are commendable. It is important to continue to work with the Federal Emergency Management Agency (FEMA) to strengthen the partnership, with other annexes having a natural co-dependence with ESF#2, and for representatives of those disciplines to participate in ESF#2 training currently being planned.

SECTION 8

RECOMMENDATIONS

The subgroups evaluated multiple issues and each subgroup made many recommendations to the Task Force. The Task Force reviewed these recommendations and assimilated them into a succinct list by combining individual items, when warranted by the similarities. Many of the recommendations apply to all the emerging technologies, such as priority access for NS/EP users and interoperability concerns.

To exploit these emerging wireless technologies, the Task Force recommends that the Government:

- Define and establish unified policies and requirements for wireless services in support of NS/EP activities at Federal, State, and local levels
- Identify NS/EP issues inherent in emerging technologies, including providing NS/EP orientation to newly involved entities
- Identify interoperability and security constraints inherent in emerging wireless technologies and determine alternative solutions, e.g., internetworking
- Identify approaches to providing end-to-end network privileges for NS/EP users associated with these new technologies, e.g., priority access, GETS, etc.
- Foster international agreements and licenses for wireless technologies to support global emergency response efforts
- Continue support to the joint planning processes, such as undertaken within the CPAS Subgroup, Federal Law Enforcement Working Group, FWPC, FWUF, Government Wireless Focal Point, NPR-IT04, NSTAC, and the PSWAC
- Establish an office that aggressively involves all NCS organizations, State and local Governments, and the telecommunications industry to test, evaluate, demonstrate, train, and exercise the application of wireless technology in support of NS/EP operations

The Government should continue its CPAS implementation efforts, coordinating with Federal, State, and local Governments, industry groups, and emergency management associations to gain broad consensus on regulatory, administrative, and technical issues and finalize a comprehensive strategy for CPAS implementation.

APPENDIX

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GLOSSARY

AMPS	Advanced Mobile Phone System
AMSC	American Mobile Satellite Corporation
ANSI	American National Standards Institute
APCO	Association of Public-Safety Communications Official
ATIS	Alliance for Telecommunications Industry Solutions
CDMA	Code Division Multiple Access
CDPD	Cellular Digital Packet Data
CELP	Code-Excited Linear Predictive (coder/decoder)
CPAS	Cellular Priority Access Services
CTIA	Cellular Telecommunications Industry Association
DITCO	Defense Information Technology Contracting Office
DUITS	Digital, ubiquitous, interoperable, transparent, and secure
ECSA	Exchange Carriers Standards Association
ESF	Emergency Support Function
ESMR	Enhanced Specialized Mobile Radio
FCC	Federal Communications Commission
FDMA	Frequency Division Multiple Access
FEMA	Federal Emergency Management Agency
FRP	Federal Response Plan
FRWG	Funding and Regulatory Working Group
FTS	Federal Telecommunications System
FWPC	Federal Wireless Policy Committee
FWUF	Federal Wireless Users Forum
GEO	Geosynchronous Earth Orbit
GETS	Government Emergency Telecommunications Service
GHz	Gigahertz
GPS	Global Positioning System
GSA	General Services Administration
GSM	Global System for Mobile communications
HEO	Highly (Inclined) Elliptical Orbit
HS	High Speed
IES	Industry Executive Subcommittee
IMBE	Improved Multi-Band Excitation (coder/decoder)
IN	Intelligent Network
IP	Internet Protocol
IRAC	Interdepartment Radio Advisory Committee
IS	Interim Standard

ISDN	Integrated Services Digital Network
IT	Information Technology
kbps	Kilobits per second
kHz	Kilohertz
LAN	Local Area Network
LEO	Low Earth Orbit
LMR	Land Mobile Radio
LS	Low Speed
MEO	Medium Earth Orbit
MHz	Megahertz
MIRS	Motorola Integrated Radio System
MSAT	Mobile Satellite
MSC	Mobile Switching Center
MSS	Mobile Satellite Service
MTSO	Mobile Telephone Switching Office
NASTD	National Association of State Telecommunications Directors
NCC	National Coordinating Center
NCS	National Communications System
NII	National Information Infrastructure
NIST	National Institute of Standards and Technology
NPR	National Performance Review
NS/EP	National Security and Emergency Preparedness
NSA	National Security Agency
NSTAC	National Security Telecommunications Advisory Committee
NTIA	National Telecommunications and Information Administration
OMNCS	Office of the Manager, National Communications System
PACA	Priority Access and Channel Assignment
PBX	Private Branch Exchange
PCMCIA	Personal Computer Memory Card International Association
PCN	Personal Communications Network
PCS	Personal Communications Service
PDA	Personal Digital Assistant
PIN	Personal Identification Number
POS	Positioning
PSDN	Public Switched Data Network
PCM	Pulse Code Modulation
PSN	Public Switched Network
PSTN	Public Switched Telephone Network
PSWAC	Public Safety Wireless Advisory Committee
RFC	Request for Comment
RFI	Request for Information

SMR	Specialized Mobile Radio
SS7	Signaling System Number 7
STU	Secure Telephone Unit
TCP	Transmission Control Protocol
TDMA	Time Division Multiple Access
TIA	Telecommunications Industry Association
TSP	Telecommunications Service Priority
UHF	Ultra High Frequency
VHF	Very High Frequency
VSELP	Vector Sum-Excited Linear Predictive (coder/decoder)
WLAN	Wireless Local Area Network
WSTF	Wireless Services Task Force